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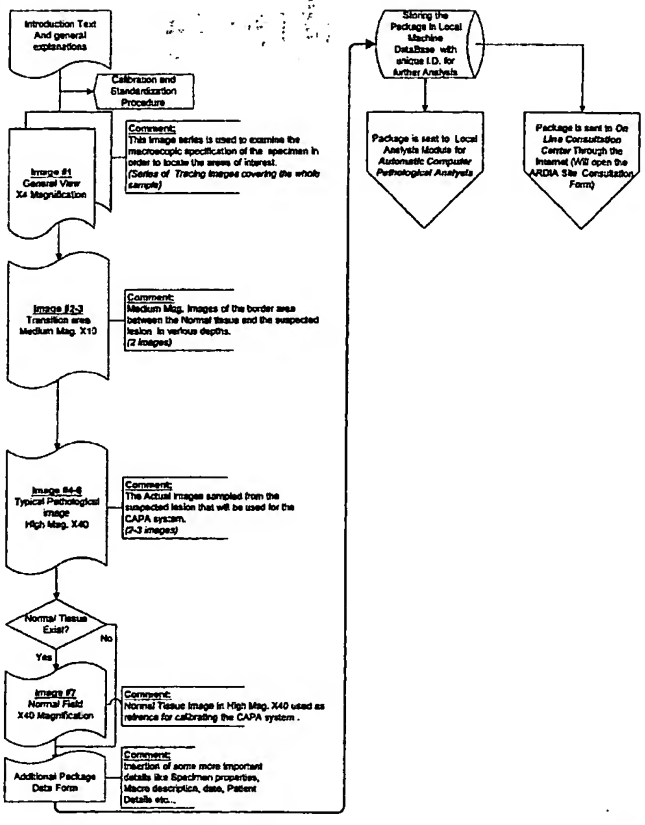

(57) Abstract: A histological system includes: a database, comprising histological images and quantitative information regarding diagnostically relevant features of histological samples;an inspection procedure for the examination of a suspected object; andanalysis tools for comparison of the locally obtained data to those stored in the database and for applying classification algorithms based on heuristically derived histological diagnoses.

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SYSTEM FOR AUTOMATED AND REMOTE HISTOLOGICAL ANALYSIS AND NEW DRUG ASSESSMENT

Field of the Invention

The present invention relates to the diagnosis and peridiagnosis of histological tissues. More particularly, the present invention discloses a method and system useful for improving and standardizing cancer detection and grading in an automated or semi-automated way and which facilitates transfer of acquired images for remote diagnosis and teleconsultation. Additionally, the present invention is useful as a system for automatic or remote assessment of new drug evaluation assays.

Background of the Invention

It is widely accepted that the need for histological analysis is part of the routine procedure for cancer detection. Cancer is a lethal disease that kills millions of patients every year. The diagnosis of cancer is based principally on techniques that have been accepted for a relatively long time. The classic diagnosis of most neoplastic diseases is carried out by means of a number of histological examinations of suspect tissues. Subsequently, for some types of cancer and for some cases in which the diagnosis is particularly difficult, other diagnostic methods are used, which are based on immunological methods comprising specific antibodies and special stains.

The presently used techniques are limited in that they are based on qualitative diagnosis, which can be highly subjective according to the experience of the pathologist. A more objective quantitative approach used for automated diagnosis has not been developed heretofore. Presently, the diagnosis procedure almost always requires performing a biopsy, in order to establish the nature of the lesion, before any treatment involving the surgical removal of the cancerous tissue, chemotherapy, etc.. Thus, pathological histology is accepted as the main means for the diagnosis of cancer. Previous developments in automatic and remote tissue sample diagnosis were all addressed to cytological diagnosis, including for example

products for Pap Smear and others that have been introduced, whereas scarce work has been conducted for automation of histological diagnosis.

Additionally, it is clear from the references which follow that a brute-force approach using many features at a time does not necessarily help; it can blur the separation between normal and malignant tissues.

The references include:

M. Kearns and U. Vazirani, "An introduction to the Computational Learning Theory", MIT Press, 1994;

M. Anthony and M. Biggs, "Computational Learning theory", Cambridge University Press, 1992;

L., G. Valiant "A theory of the learnable". Communications of ACM, 27(11), 1134-11422, 1984;

A. Blumer, A Ehrenfeucht, D. Haussler and M. Warmuth, "Learnability and the Vapnik-Cheronenkis dimension", Journal of the ACM, (4), 929-965, 1989;

"A Note on VC-Dimension and Measure of Sets of Reals" by S. Ben-David & L. Gurvits; and

"Combinatorial Variability of Vapnik-Chervonenkis Classes" by S. Ben-David & A. Litman.

Objects and Summary of the Invention

It is a purpose of this invention to provide an improved method for the performance of histological analysis, particularly in respect to the diagnosis of cancer.

It is another purpose of this invention to provide a histological analysis system, which is operable, at least partially, in an automatic manner.

It is a further purpose of this invention to improve diagnostic procedures, to dramatically reduce the danger of false positive or false negative diagnoses.

It is a still further purpose of the invention to offer a new quantitative approach to automate the diagnosis process, presently carried out by pathologists, by use of advanced methods supported by AI software tools.

It is a still further purpose of the invention to provide the pathologist with guidance in this process and to offer a friendlier operating environment to expert pathologists

It is a still further purpose of the invention to apply to the diagnosis process the full advantage of modern communication means and advanced video HW to allow telediagnosis and teleconsultation between experts in severe or marginal cases.

These and other objects not mentioned hereinabove are accomplished by this invention, which provides an extendable database comprising diagnostically relevant features of images and quantitative information (meta-data) supporting them. Typically, the diagnostically relevant features are textural, morphometric, colorimetric and densitometric in nature.

Preferably, the quantitative information is based on a structure and program that are designed so as to provide to the extendable database completeness, accessibility, and as far as possible, universal value.

Optionally, a web site related to the present invention is constructed, comprising a database in accordance with the present invention, system support, pathology information and pathology consultation means.

The invention further comprises an inspection procedure for the examination of a suspected tissue using a motorized stage.

The invention further comprises an embodiment wherein the extendable database is local to the acquisition of data, and where the diagnosis is to be carried out. The local acquisition of data is preferably based on a structure and programming, described further hereinbelow, which correspond to those of the database, so as to facilitate, and preferably to permit, insofar as possible, comparison, feature by feature, of the data obtained locally, representing a specific patient, to those stored in the database.

The database features to be compared are selected by the following procedure:

1) Defining pathologists conclusions regarding an image by a number of features;

2) Reducing said features to mathematical formulas;
3) Using algorithms based on the mathematical formulas to compare numerical data obtained locally with the data comprising the system's database; and
4) refining the conclusions by using artificial intelligence tools.

By means of image capturing devices, at least six images are acquired: one image, of normal tissue near its border with suspected tissue, two images of the boundary between the suspected tissue and normal tissue, two more of the suspected tissue only, and one image in lower resolution of the entire suspected area. Then the images undergo a standardization procedure and object features as well as textural features are extracted. The features are compared to the data comprising the database. The comparison results are not just a binary decision but a graded scoring (for example between 0 and 1) that measures the "probability" or grade of malignancy. The comparison is accomplished by means of such artificial intelligence models as the SVM (support-vector machine) technology, as is described in detail in the publication "A Tutorial on Support Vector Machines for Pattern Recognition", Christopher J.C. Burges, Data Mining and Knowledge Discovery 2, 121-167, 1998, the disclosure of which is entirely incorporated herein by reference for its teaching as to the state of the art on how to use and construct an SVM.

The invention further comprises what may be called a peridiagnosis system, which includes the transfer of images of relevant tissues over the Internet or telephone lines for examinations by experts at locations different from that at which the diagnosis is to be carried out. This transfer via the Internet can be with or without the diagnostic results extracted by the system. The transfer procedure requires validation of the received images in order to insure that the images don't suffer from significant distortion, which can have a destructive effect on image examination.

From the apparatus viewpoint, the diagnosis system of the invention comprises, as components, a standard microscope used in pathology applications, computers, image capturing devices (from microscopes), and telecommunications means. The apparatus components are supplemented, and their operation is improved and controlled by specific diagnosis software.

Brief Description of Drawings

Figs. 1A and 1B are photomicrographic images of normal and cancerous tissue respectively and Fig. 1C is an enlarged detail of Fig.1B;

Fig. 2 is a diagram comparing measurement of shape factor values of the normal and cancerous tissues shown in Figs. 1a-c;

Fig. 3 is a flowsheet schematically illustrating the analysis of pathology samples, according to an embodiment of the invention;

Fig. 4 is a flowsheet illustrating the operation of data preparation, which is part of Fig. 3;

Fig. 5 is a schematic block diagram illustrating an embodiment of Web Site of the invention;

Fig. 6 is a flowsheet illustrating the pathology consultations using said Web Site;

Fig. 7 illustrates a Petri dish carrying out an NDA procedure, in accordance with an exemplary embodiment of the present invention;

Fig. 8. illustrates a sample results graph created by the software of the present invention displaying imaging results derived from Petri dishes used for carrying out a new drug assessment, in accordance with another exemplary embodiment of the present invention;

Figs. 9a and 9b are tissue samples showing normal and malignant tissue histological sample images, respectively;

Fig. 10a and 10b are tissue histological sample images of malignant and normal tissue showing differences in the complex parameter Heterogeneity and Density;

Fig. 11 is a flow sheet showing the flow of image acquisition and image analysis in an exemplary embodiment of the present invention;

Figs. 12 (1-7) and (8-16) is Table 1 comprising data values for new features and complex features on Normal Tissue and old features and complex features on Normal Tissue;

Figs. 13 (1-7) is Table 2 comprising data values for features and complex features on Malignant Tissue;

Fig. 14 is bar graphs showing the features from Tables 1 and 2;

FIG. 15 are Best Couples graphs showing couplings of the data of features and complex features from Tables 1 and 2;

FIG. 16 are Scatter Graphs of data for features from Tables 1 and 2 combined for input into the SVM;

FIG. 17 are Scatter Graphs of data for features from Tables 1 and 2;

FIG. 18 a-c are slides showing a sample as a raw image, enhanced and flattened, respectively; and

FIG. 19 is an example of an SVM plot based on two complex features Best Heterogeneity versus Density.

Detailed Description of Preferred Embodiments

Fig. 1A shows a photomicrographic image of a normal tissue. Fig. 1B shows a comparable image of a cancerous tissue. The images were obtained using regular

biological optic magnification of 40X and color video camera with resolution of 768 x 572 pixels. Fig. 1C shows a borderline case in which it is with difficulty that a firm diagnosis can be made.

Fig. 2 compares normal and carcinoma measurement values of one parameter (Shape Factor). The values indicated by blank rectangles are the normal ones and those indicated by black rectangles are the carcinoma ones. The Statistics results are: Normal Average 0.79 Std, (Standard Deviation 0.036)– Carcinoma Average 0.83 Std (Standard Deviation 0.053), i.e. a large area of overlap and hence difficulty in diagnosis

Whereas the feature demonstrated above only partially separates malignant and normal tissue, the use of multiple features supported by powerful AI techniques yields a high level of reliability in the detection of cancer.

The flow sheet of Fig. 3 illustrates the system of analysis of pathology samples. Since there are different types of cancerous phenomena, which differ as to their character, form and location, in order to diagnose a cancerous growth it is necessary to provide a search kernel that is optimal for each kind of growth. Search kernels are arrays of data, which are expanded and updated frequently. The search kernel for a particular tissue type and patient parameter which will serve as the basis for initial diagnoses, and which will be refined bas diagnoses are added to the extendable database by the SVM as , is initially defined by taking an actual heuristic diagnostic decision from an expert pathologist and translation of the pathologist's input into mathematical algorithms. However, since it is clear that some intangible quality, call it experience or gut-feeling, colors a pathologist's decision-making process, the present invention seeks to employ AI techniques, for example SVM, to fill in the gaps between the pathologists decision and the resulting mathematical formuka and algorithms derived therefrom. SVM is also used to enrich the kernel of features by trying to detect patterns between features previously thought to be unrelated by pathologists, which may have been too subtle for human's to be consciously aware of.

Thus, the system comprises a Learning Mode in which samples of tissues that were already manually diagnosed are analyzed in order to build the search kernel, which is

a subset of the features vector or morphometric and/or pathologic features which distinguish cell-types and malignancy types for any particular pathology, and an Analysis Mode in which the search kernel is applied and subsequently refined. In the Learning Mode no new samples are selected; the pertinent data are prepared and the learning procedure is followed. If significant information is thus acquired, the search kernel is searched for analysis in order to update the system. If no significant information is obtained, the procedure returns to the stage prior to the selection of known samples.

In the Analysis Mode, an unknown sample is analyzed. The pertinent data are prepared as will be described hereinbelow and an analysis is carried out by using the search kernels derived from a prior learning system. The results are attributed either by a tumor probability sign, which conveniently is between 0 and 1 or by a sign representing the tumor degree.

The preparation of data is illustrated in Fig. 4. It comprises the steps of searching the slide samples, obtaining the grab and normalized images, normalization of the selected image (i.e. adjusting light intensity, contrast, etc.), image enhancement, carrying out a special image analysis, and obtaining the image data, which then undergoes local individualizing analysis to adjust for normal variances within a patient population.

Fig. 5 illustrates an example of a Web Site related to the system. The Web Site provides pathology information, system support and pathology consultations. The pathology consultation scheme is illustrated in Fig. 6 and comprises selecting an advisor, sending data and pay, and obtaining the appropriate results.

In the exemplary embodiment of the invention, the Web Site comprises a remotely accessible database, which includes quantitative data extracted from the images by the learning mode and a searching kernel for the tissue type of the requested histological exam. Access to the web site enables analysis of new samples by using the search kernel and AI (artificial intelligence) software to compare features locally extracted to features presented by database.

Image Acquisition Stage

In accordance with Figs 3 and 4, the learning mode software component of the invention determines what data – images, parameters, and other quantitative data – are required or desired for a complete database in order to construct a search kernel. The same software controls the operation of the local diagnostic system. While carrying out the invention, image analysis software enables either an intelligent scan of the specimens to locate region of interest where the significance of the data is higher or aid the pathologist in his manual navigation within the image. By means of the capturing devices, at least six images are acquired: one, a general view, at 2x-6x magnification, is used to examine the macroscopic specification of the specimen in order to locate the areas of interest. Two images – medium magnification 5x-20x, of the boundary area between the normal tissue and the suspected lesion in various depths, two more of the suspected lesion itself, and one image in high magnification 20x-100x, used as reference for calibrating the system. Then the images undergo a standardization procedure controlled by analysis software component.

The first stage of the automatic image standardization procedure comprises color and light correction, calibration and thresholding of color lighting etc. for comparative purposes of tissue, cellular and nuclear behavior. Standard, off-the-shelf image enhancement software may be used at this stage. In the next stage, the invention first compares the range of features in the normal-tissue image to a search kernel, which comprises an updated standard determined by the system, and then sets accordingly the thresholds of the features extracted by the system for the diagnosis of expected malignancy. The "individualization" algorithm hereby addresses the natural variance in the normal population, facilitating higher sensitivity in detecting malignancy overcoming. Once, a salient image is acquired, and the image standardization algorithms are carried out, the image is analyzed in depth by computer vision and/or imaging programs that perform measurements according to the desired features which make up the vector for the tissue type, and provide values for the vector of features derived from the image in accordance with the kernel.

The individualization program essentially compares the readings for the features of the vector for both the normal tissue sample and the suspected tissue sample of the particular patient against Gaussian curves for each of those features. Once it is

determined where along the "normal" curves the patient's readings fall, all of the data set for that patient are adjusted accordingly. For example, if it is seen that both the normal and suspect tissue samples of the patient appear to lie at the low end of the curves for a particular feature (e.g. nuclear density), then all the data which correlates with that feature will be adjusted accordingly, practically in a point-to-point manner.

An alternative embodiment of the invention comprises a smart scanning procedure that detects the boundary layer and automatically acquires images along it. This alternative enables the pathologist to get a general knowledge about the case, before beginning his diagnosis.

Analysis stage

The desired feature vector is classified using advanced pattern recognition methodologies supported by support-vector machine (SVM) technology or neural network or fuzzy logic or similar AI methodology. A feature vector is the entire class of morphologic and/or pathologic features which are measurable in a histological sample. A desired feature vector may be a somewhat limited subset of features taken from a feature vector, for example depending on age range of the patient, race or some other macro demographic or biological group factor. A desired feature vector forms a master set of features from which specific features are selected for defining a search kernel. Regarding the learning-mode, these methodologies enable the training of classifiers for recognition of patterns based on offline learning from data classified normally by expert. (see "An Overview of Statistical Learning Theory" by V.N. Vapnik).

Supervisory software which supervises the software components of the invention then constructs a data-package file comprising the normalized and individualized raw features extracted from the images, and other details such as specimen properties, macro description (general observations such as landmark locations in low magnification image), date, patient details etc. The file is stored in a database with a unique I.D. Then the file is either manually analyzed by one or more pathology consultants and/or sent for computer automated pathological analysis (CAPA) performed per the search kernel. The analysis software guided by the search kernel controls the comparison of the data, relative to a specific patient, to the data

comprising the database. The comparison results in a diagnostic conclusion in at least one of the following ways, or a combination thereof. Where the diagnostic process occurs in an automatic manner, the analysis software may completely control the formulation of diagnostic conclusions carried out according to the search kernel. The results that appear are preferably not a binary decision but a graded scoring that measures the "probability" or the degree of malignancy (optionally implemented by neural network (NN) or Fuzzy Logic). Alternatively, although diagnostic conclusions can be drawn automatically, analysis of the comparison of data may be carried out in an interactive manner with pathology experts. It is also possible, in difficult diagnostic situations to have both the analysis software and experts work in parallel and interactively.

An object of the present invention is interpreting heuristic / subjective information used by the pathologist and converting it to quantitative data, which can be used in the partially or totally computerized diagnosis. As mentioned above, the search kernel carries out the main part of the local analysis by comparing features of acquired images to features comprising the database. The determination of what features are required for the search kernel is made by Interpreting heuristic information typically used by a pathologist and converting it to quantitative parameters.

Tables 1 and 2 illustrate the raw data for features extracted by an analysis procedure based on a search kernel built for diagnosis of carcinoma.

The conversion process is carried out as follows:

1) Definition of a top- pathologist's heuristic conclusion from an image by a number of specified features and complex features (where possible); and

2) Reduction of said features to mathematical formulas.

Comparison is then performed, by algorithms based on the mathematical formulas, of numerical data obtained locally, i.e. from the specific sample in question, with the data comprising the systems database and refinement of the conclusions using artificial intelligence tools (SVM).

Complex features comprise combinations of morphological and/or pathological features which are shown, by SVM or by observation using the software of the present invention, to somehow be linked in occurrence with respect to particular types of malignancies. Complex features are shown hereinbelow to be particularly accurate in distinguishing between malignant and normal tissue. Complex features include: Heterogeneity_Density, Silhouette, Heterogeneity, Fractal Dimension, Density Aspect, Density Std (Standard Deviation). Another complex feature may be the combination of Angle and Aspect Ratio. Heterogeneity refers to gray levels inside nucleus. Density means nuclear density. Silhouette means combination of Aspect Ratio and Roundness. Fractal Dimension refers to shape of nucleus. Density aspect refers to variation in nuclear gray-levels.

More particularly, the approach of the present invention is to use the prior knowledge of the pathologist and to convert that to mathematical algorithms. It is different from known neural networking as it provides greater control on the criteria used and on their priority. To sharpen the dialogue between the pathologist and the algorithm, 4 levels of binarization may be used to characterize the image. The pathologist's subjective description of the histological sample is found in these 4 levels.

The following is an example of a technique developed to set these 4 ranges in the most accurate way. Two magnifications are used in the automated process - 4X for initial determination of the various layers in the tissue. As we are discussing first the carcinoma of the epithelial tissues then the layers are: basal cells, spinous cells, keratin cells from the normal internal tissue to the skin boundary respectively. Once the various layers are determined higher magnification, 40X, images are acquired and analyzed using the vector of features.

An algorithm is applied to pre-sort the acquired images and determine whether they can be used for automatic classification or the user should be prompted to acquire improved images. Pre-sorting assures that low quality images with inaccurate focus, saturation, poor staining etc. will not degrade the decision process.

The binarization technique effects a representation of the various layers of a histological sample, among them are background, nucleus and cytoplasm.

As the inspection is histological, several textural criteria are used to classify the tissue, among these are fractal, intensity variance, nuclear density, heterogeneity, area, aspect, cellular density, standard density, perimeter, roundness, diameter at an angle, diameter in silhouette, aspect density, heterogenity density, etc. These are also useful in combination with a textural algorithm for orientation determination. This orientation determination algorithm is based on orientation of a cell and its nearest neighbor. It reflects the subjective appearance of "flow" seen on tissues.

Observations on tissues have indicated that there is a large variation between normal tissues of different people. This fact blurs the classification between normal and malignant tissues. To overcome this problem the present invention determines first the range of features in a specific normal tissue and accordingly sets the range of features for expected malignancy. This "individualization" algorithm facilitates higher sensitivity in detecting malignancy by accounting for the natural variance in the normal population.

Out of the possible features vectors available, the present invention uses different sub-sets for the different zones. In each zone we apply the sharpening procedure compared to the statistics of a normal specific tissue.

In general, as was discussed hereinabove, it is advantageous to limit the number of features used for the actual decision and to use the features that indeed represent the mode of decision of the pathologist. Further the complexity of the process of inspection increases according to n cubed where n is the number of features. As such different features are used for different zones and also we have made a special effort to define sets of features as one feature which has better correlation to human observation. For example the multiplication of ARXSF better represent elongated objects with fuzzy edges. We have defined 8 such complex features and they better differentiate between normal and malignant tissues. With reference to our results of conventional features compared to the 8 complex features, the superiority of the complex features is clear.

It is worth while to elaborate here and to explain that the incentive is to develop an

easy to use cost effective system. To take hundreds of features with no prioritization raises the system cost and complexity without really improving the accuracy compared to the present invention wherein, as much as possible, the system benefits from procedures, experience and methodologies of top pathologists.

The decision process itself is based on a SVM algorithm which is compatible with the classification rational outlined above, taking full advantage of the pathologist experience.

The present invention uses composite features, such as cell silhouette, perimeter at an angle, diameter at an angle. The composite features are optimized per layer.

As an example, with reference to Figs. 9a and 9b, there is shown two images, one normal and the second malignant, respectively. Measurement is automatically done to obtain the mean and standard deviation of a conventional feature - the Aspect Ratio, versus the mean and standard deviation using one of the composite features - the silhouette. This is done for both the normal tissue and the malignant tissue. The results appear below:

Normal Tissue Sample		Mean	Standard deviation (Std)
	Aspect Ratio (AR)	2.49	1.17
	Silhouette	6.15	10.9

Carcinoma Tissue Sample		Mean	Standard deviation
	Aspect Ratio (AR)	2.20	1.27
	Silhouette	137	85.5

It is apparent that the mean shows emphasized difference between normal and malignant tissues when one compares the mean or Standard Deviation of AR for

Normal versus the mean for AR of Carcinoma. Similarly, comparison of the composite feature Silhouette shows emphasized differences whether one looks at mean or Standard Deviation. A combination of composite features thus also lowers the Std and facilitating a high percentage of correct classification.

In addition the AI tools can compensate for heuristic decision factors, which can't be reduced to mathematical formulas but still, in some cases, have significant effect on the pathologists decision (the "gut feeling" factor). One preferred AI technique which may be used by the present invention, as has been previously mentioned, is the SVM (support vector machine). Thus, features, even those not in the search kernel, may be processed to by the SVM to try and detect subtle relationships which could affect how the search kernel appears in the future.

The Image Analysis procedure examines textural properties extracted from the acquired image such as granularity, density of the cell nuclei, fractal dimensions etc. Those measurement results can form a basis for the predicate calculations used by the search kernel and the AI techniques.

As mentioned above, another aspect of the present invention is the support of the pathologic inspection by telediagnosis and teleconferencing

The procedure of transmitting the images can introduce distortion and errors into the images and therefore the invention provides validation of the received images in order to insure that the images didn't suffer from significant distortion.

In addition, the present invention provides enabling the receiver of the images to decide what images should be included in the diagnosis procedure (manual or automatic procedure) for effective telediagnosis. This property is achieved by sending many images, each image sent together with registration data, wherein the receiver is able to navigate between the images and pick whatever images he wants.

An exemplary embodiment of the invention comprises the construction of a special Internet portal, holding the database for comparative analysis and also providing options of

(1) Local acquisition of new information and updating search kernel accordingly;
(2) Acquisition of expansions of the system;
(3) Consultation with a group of pathology experts for the various types of cancer. These experts operating in the portal use the special computerized diagnostic tools as part of their evaluation.

The system also may support upload and download of database image packets (i.e. the packets formed by the images and their raw data values) and search kernels from aforementioned Internet portal or mirror site databases. A user of a system according to this invention may enter the Web Site and to enlarge the capability of his own system by retrieving the systems kernel data arrays. Thus it is possible to add new analysis capabilities or new kernels for different kinds of cancer or to improve the performance of the diagnostic system.

In addition to the consultation between colleagues, as hereinbefore described, a Web Site facilitates consultation with a number of known pathologists, who reply to the questions posted to the Web Site, or discuss and suggest solutions to urgent problems which are brought up using advanced real time consultation facilities.

Examples of hardware that is included in the local diagnostic means are personal computers, frame grabbers, color TV cameras, biological microscopes etc.

In addition to the aforementioned web site, several methods of telediagnosis can be used in carrying out the present invention. The diagnostic system can be on both sides of the communication link or only on the transmitting side or only on the receiving side. The first method allows implementing the diagnosis routine on both ends (using image-capturing techniques) wherein the database is significantly enlarged taking advantage of the cooperation between the two sources communicating. In the second method, automatic diagnostic results and images are transferred, for further diagnosis. In the third the diagnostic system and the expert are in the receiving side and the transmitting side just provides the relevant images by means of image capture and transfer (according to image capture provisions).

In another embodiment of the present invention the transmitting side provides a file comprising figures describing the entire suspected tissue, permitting choice of images by the receiver for re-running an auto analysis or performing one manually. In order to enable navigation through the received images, the images are sent together with registration data, which arranges all the images into a "big image" insuring the regional relationships between the sent images are right.

This offers a cost-effective solution for automatic pathologic diagnosis.

With reference to apparatus viewpoint, according to an embodiment of the invention, there are three methods of image capture and transfer:

1) The use of a 2D camera and a frame grabber that will interface at the required bandwidth to the communication channel;
2) The use of a digital 2D camera to interface to the computer memory from which the data is then transferred via the communication channel;
3) The use of a 1D camera and a scanning stage with high resolution to scan the image and construct a 2D image in the computer memory. This latter technique is especially advantageous and cost effective in acquiring high-resolution images. It is very useful also for other medical images such as X-ray and MRI.

New Drug Assessment and Monitoring

An additional embodiment of the present invention is a method for new drug assessment (NDA). The need to assess new drugs is growing with the progress made in biotechnology. Since the assessment should comply with the FDA regulation, careful supervision on the experiments is very important for the drug industry. One of the techniques used in NDA is the interaction of the drug with known cultures or germs, or verifying its interaction with living tissues. The technique known in the art, to inspect the interaction, is visual inspection of the samples and determination of the level of interaction. The present technique also sets the limit of concentration required for effective interaction. Whereas the inspection procedure is well defined, the verification of the test by the drug manufacturer is cumbersome and the ability for remote inspection is very limited.

The present invention's features of remote image normalization (standardization) and analysis capability and web interconnection, facilitate remote supervisions of new drug assessment trials. The present invention enables the application of a pre-defined inspection algorithm and later transmission of the analyzed data as well as the visual image to the drug company for inspection and archiving. The present embodiment allows standardization of experiments conducted around the world, and thus better tracking and faster cycle time in the evaluation of a new drug. By way of example the following description relates to antibiotics specifically. However this embodiment can be used for other applications where the need for central inspection using visual information exits.

Two methods are suggested for carrying out the present embodiment:

1) In the first method a microbiological culture of microbes colors a Petri dish and acts as a breeding ground. Six separate centers of nuclei of antibiotic matter, in different concentrations, are spread in the Petri dish. After an indicated period the Petri dish is observed visually. The areas in which the antibiotics have operated will look like a bright circle, free of microbes around each antibiotic center. The efficiency of the antibiotic matter is a function of the I.O.D. [NIR: STANDS FOR?] value in relation to the concentration of the matter in each center.

   In accordance with the present invention, this first method comprises the following stages:

   a) Taking a photograph of the Petri dish.
   b) Correction of the picture and its normalization in accordance with the first picture that contains the background surface of the optical apparatus.
   c) Finding the antibiotic centers and calculation of analyze barrier.
   d) Full analysis, which will define the circles around the antibiotic centers and will calculate the I.O.D.
   e) Showing results: a scheme of I.O.D. in dependency with the antibiotic concentration.

2) In the second method a microbiological culture of microbes colors the Petri dish and is used as a growth ground. In the center there is a stripe containing antibiotic matter in changing concentration. After incubation time microbe free surfaces will

appear around the stripe. Antibiotic efficiency will therefore be according to the size of the clear surface in dependence with the concentration.

In accordance with the present invention, this second method comprises the following stages:

a) Taking a photocopy of the Petri dish.

b) Correction of the picture and its normalization in accordance with the first picture that contains the background surface of the optical apparatus.

c) Building a concentration picture around the examined stripe and showing it as a picture in which height lines correspond the concentration

d) The result will be the measure of the concentration on the first place over the stripe around which the microbe free surface size will be higher than the minimum value.

It is apparent that the invention provides a new system for diagnosis and telediagnosis of histological tissues. There are various aspects to the invention, which are original as a whole but also individually. These aspects are: an established computerized hierarchy of the diagnosis process, a procedure for an automatic scanning routine along the boundary layer, an algorithm library for analyzing the tissue and determining the malignant cases, an AI algorithm that support the decision process as well as facilitates quantification of heuristic/subjective impressions used by the pathologist, means for image capture especially for stationary images and transfer via the Internet or conventional telephone lines, means for man-machine interaction on the remote unit that will simulate as much as possible the real interaction, and an Internet portal for consultation using the procedure suggested here as the base line. Other benefits of the present invention are the ability to archive and to track history.

Whereas the major aim of the present invention is in pathology, the image capture and scanning procedures are relevant and applicable to other areas where analysis of high-resolution images is required, a few examples are being X-ray and MRI imaging procedures.

CLAIMS

1. A histological system including:
   (1) A database, comprising images and quantitative information on diagnostically relevant features.
   (2) An inspection procedure for the examination of a suspected object.
   (3) Analysis tools for comparison of the locally obtained data to those stored in the database.

2. A system according to claim 1, wherein the diagnostically relevant features are textural, morphometric, colorimetric and densitometric features.

3. A system according to claim 1, wherein the database is based on a structure and program that are designed so as to provide the database completeness, accessibility, and as far as possible, universal value.

4. A system according to claim 1, wherein the local acquisition of data is based on a structure and program which correspond to those of the database, so as to facilitate comparison, feature v. feature and/or complex features v. complex features, of the data locally obtained and representing a specific object, to those stored in the database.

5. A system according to claim 1, comprising an automatic image standardization procedure.

6. A system according to claim 5, wherein the automatic image standardization comprises color and light correction, calibration and thresholding for comparative purposes of cellular and nuclear structure and determination of areas of interest.

7. A system according to claim 1, comprising capturing images from both normal and suspected tissues for normalization of the features of specific image according to systems threshold, and extracting object's and textural features.

8. A system according to claim 1, which includes transferring images of relevant tissues over the Internet for examinations by experts at a location different from that at which the diagnosis is to be carried out.

9. A system according to claim 1, which comprises, as components, microscopes, computers, image capturing devices and telecommunications means.

10. A system according to claim 9, where the components are supplemented, and their operation is improved and controlled, by AI-based diagnosis software.

11. A system according to claim 1, further comprising a procedure for searching the suspect tissue along the two sides of the boundary layer using a motorized stage. Add registration

12. A system according to claim 11, comprising an interactive method for transferring commands to move said motorized stage on a remote microscope.

13. A system according to claim 11, comprising initial scanning of the tissue according to a defined routine, performing initial analysis and thus giving the expert an initial indication on the examined tissue.

14. A system according to claim 1 designed particularly for the diagnosis of cancerous growths.

15. A system according to claim 14, further comprising analyzing the data acquired and obtaining guidance to probability of cancerous tissue and/or to the need for more information.

16. A system according to claim 1, comprising:

(1) An AI software for controlling the acquisition and storing of data for the database.

(2)An AI software for the operation of a local diagnostic means, means for transmitting said local diagnostic data to an Internet Web Site, means for comparing said local data with those comprised in the database and means for reaching from said comparison a diagnostic conclusion.

17. A diagnostic system according to claim 16, wherein the diagnostic conclusion is reached in an automatic manner.

18. A diagnostic system according to claim 16, wherein the diagnostic conclusion is reached with the intervention of experts.

19. A diagnostic system according to claim 17, wherein the AI software defines what images, parameters, and other quantitative data are required or desired for a complete database.

20. A diagnostic system, substantially as described and illustrated.

21. A system and apparatus for new drug assessment (NDA) comprising:
    1) Visual examination of an experiment.
    2) Correction of the picture and its normalization.
    3) Communication means for transmission of said data to any preferred location.

22. A system and apparatus for remote supervision of NDA experiment.

23. A pre-defined NDA inspection algorithm

24. A system and apparatus for transmission of normalized visual data to a different location for further analysis.

25. A system and apparatus for transmission of visual data to a different location for normalization and further analysis.

26. A system and apparatus for transmission of normalized and analyzed visual data to a different location for inspection and/or archiving.

Figure 1A: Normal

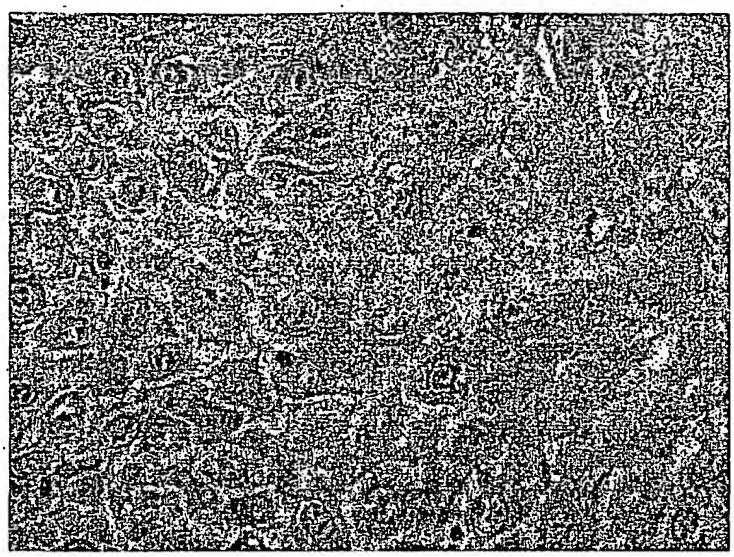


Figure 1B Carcinoma

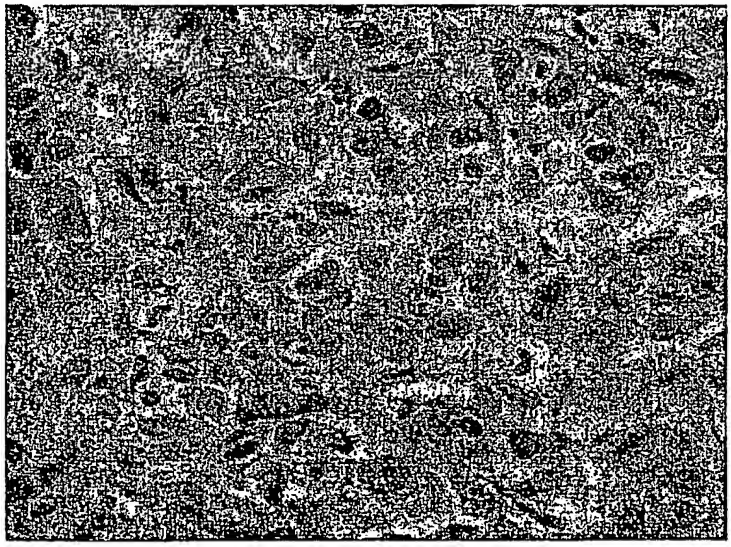


Figure 1C : Borderline case - Normal or carcinoma?

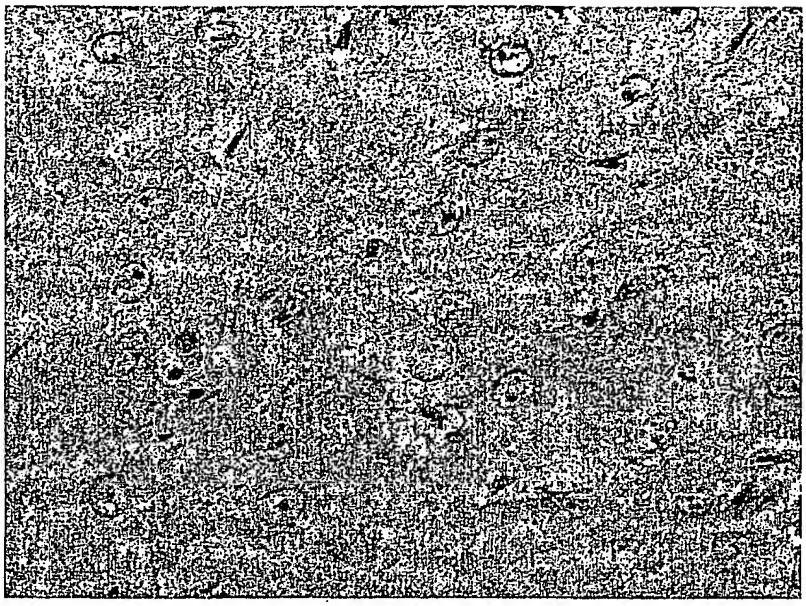
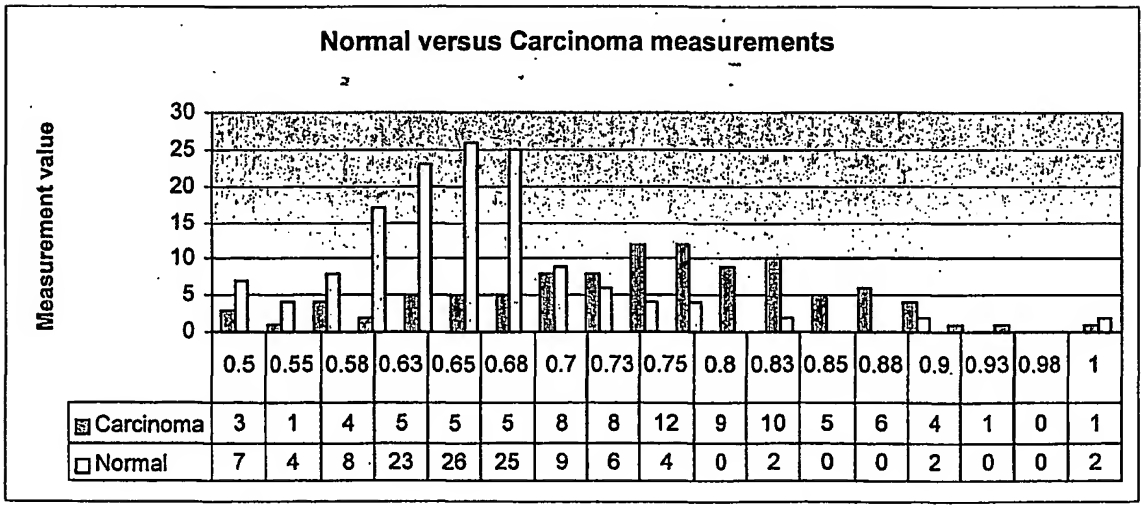


Figure 2:



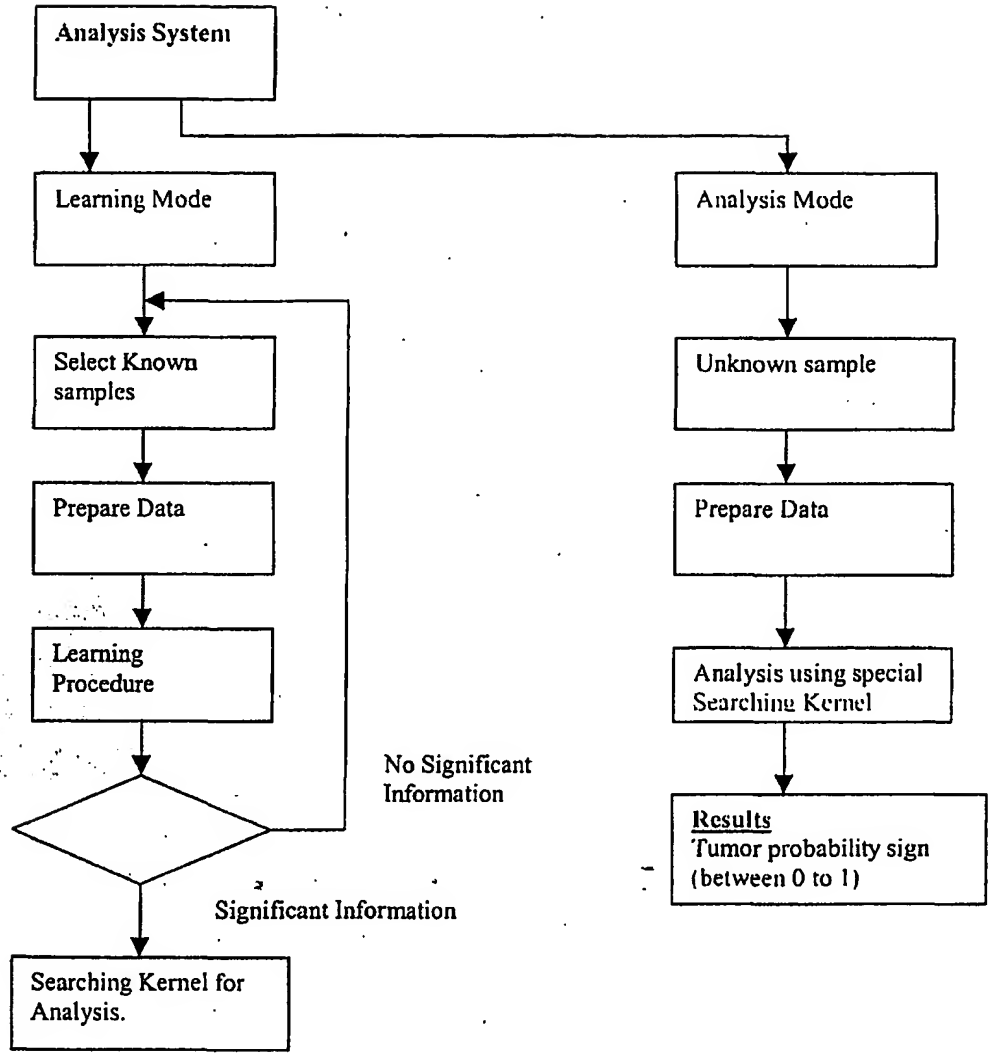

Analysis System
Learning Mode
Analysis Mode
Select Known samples
Unknown sample
Prepare Data
Prepare Data
Learning Procedure
Analysis using special Searching Kernel
No Significant Information
Results
Tumor probability sign (between 0 to 1)
Significant Information
Searching Kernel for Analysis.

Fig. 3

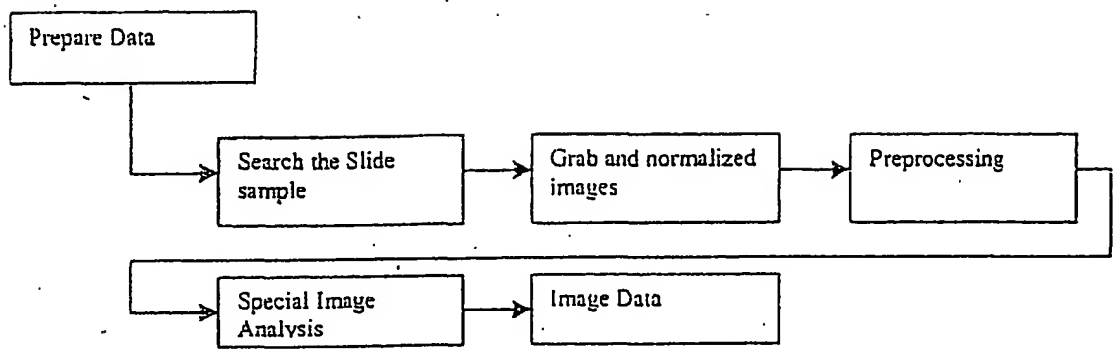

Prepare Data
Search the Slide sample
Grab and normalized images
Preprocessing
Special Image Analysis
Image Data

Fig. 4

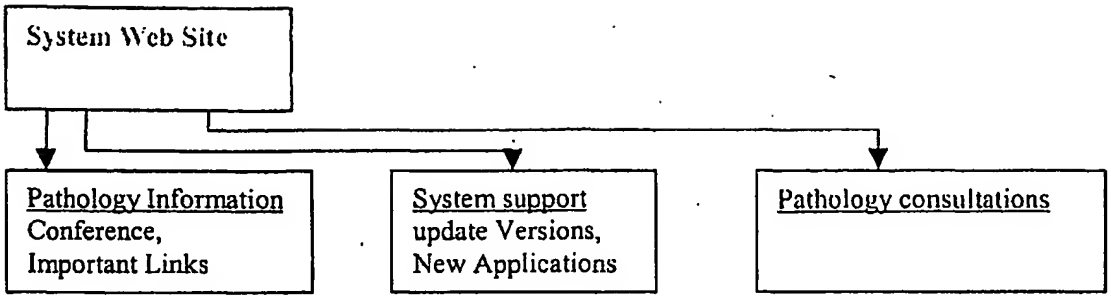

System Web Site
Pathology Information
Conference,
Important Links
System support
update Versions,
New Applications
Pathology consultations

Fig. 5

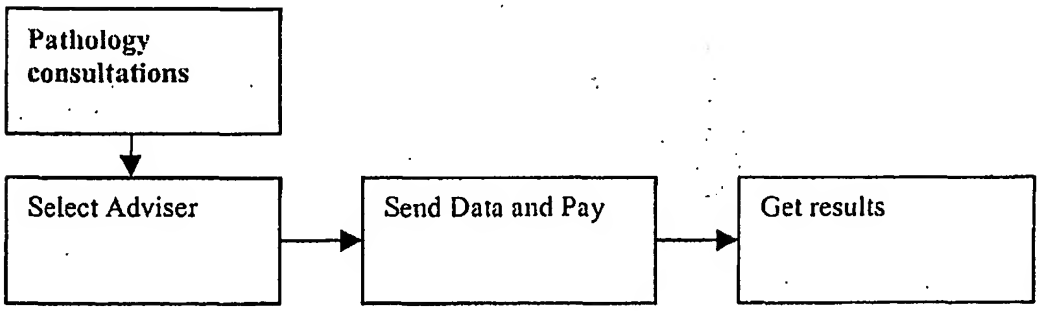

Pathology consultations
Select Adviser
Send Data and Pay
Get results

Fig. 6

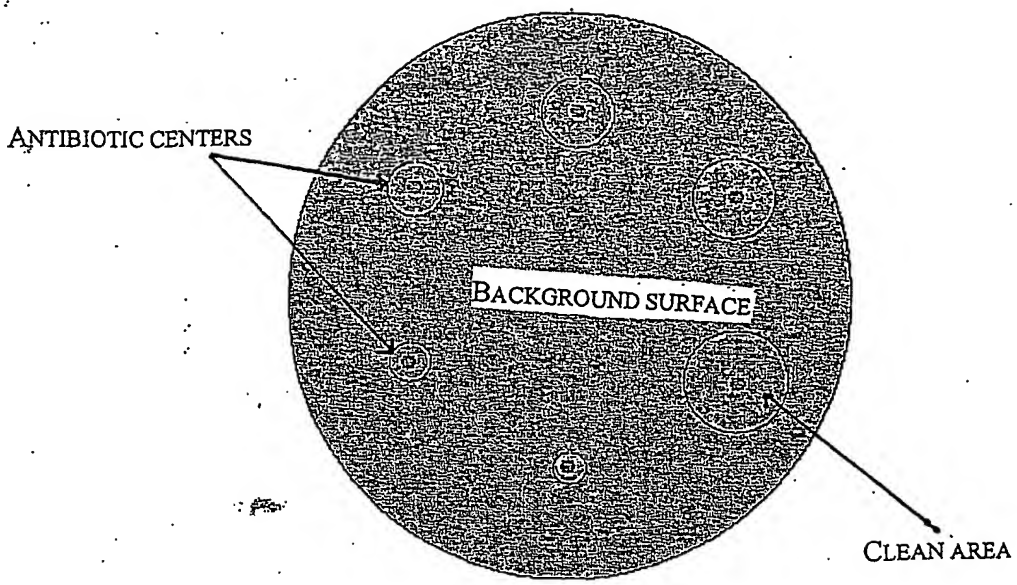

ANTIBIOTIC CENTERS
BACKGROUND SURFACE
CLEAN AREA

FIG 7

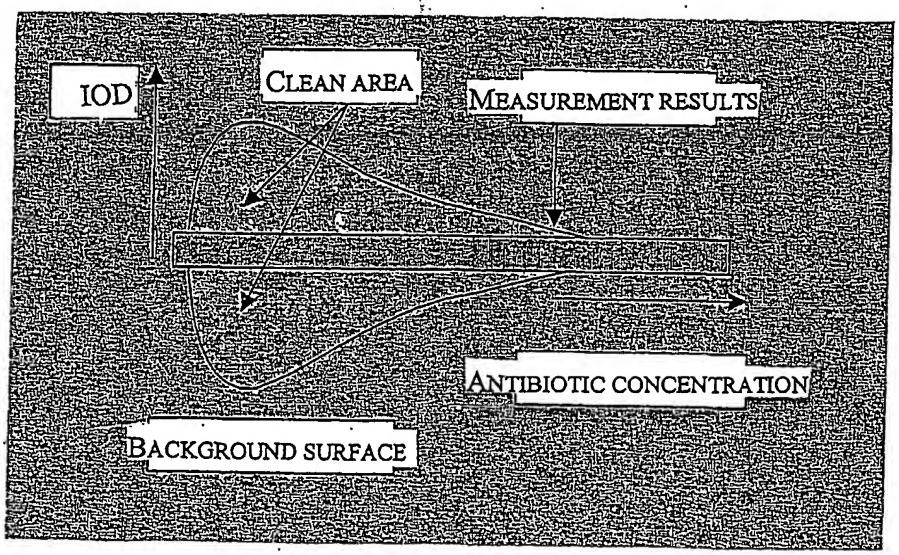

IOD
CLEAN AREA
MEASUREMENT RESULTS
ANTIBIOTIC CONCENTRATION
BACKGROUND SURFACE

FIG 8

Fig. 9a

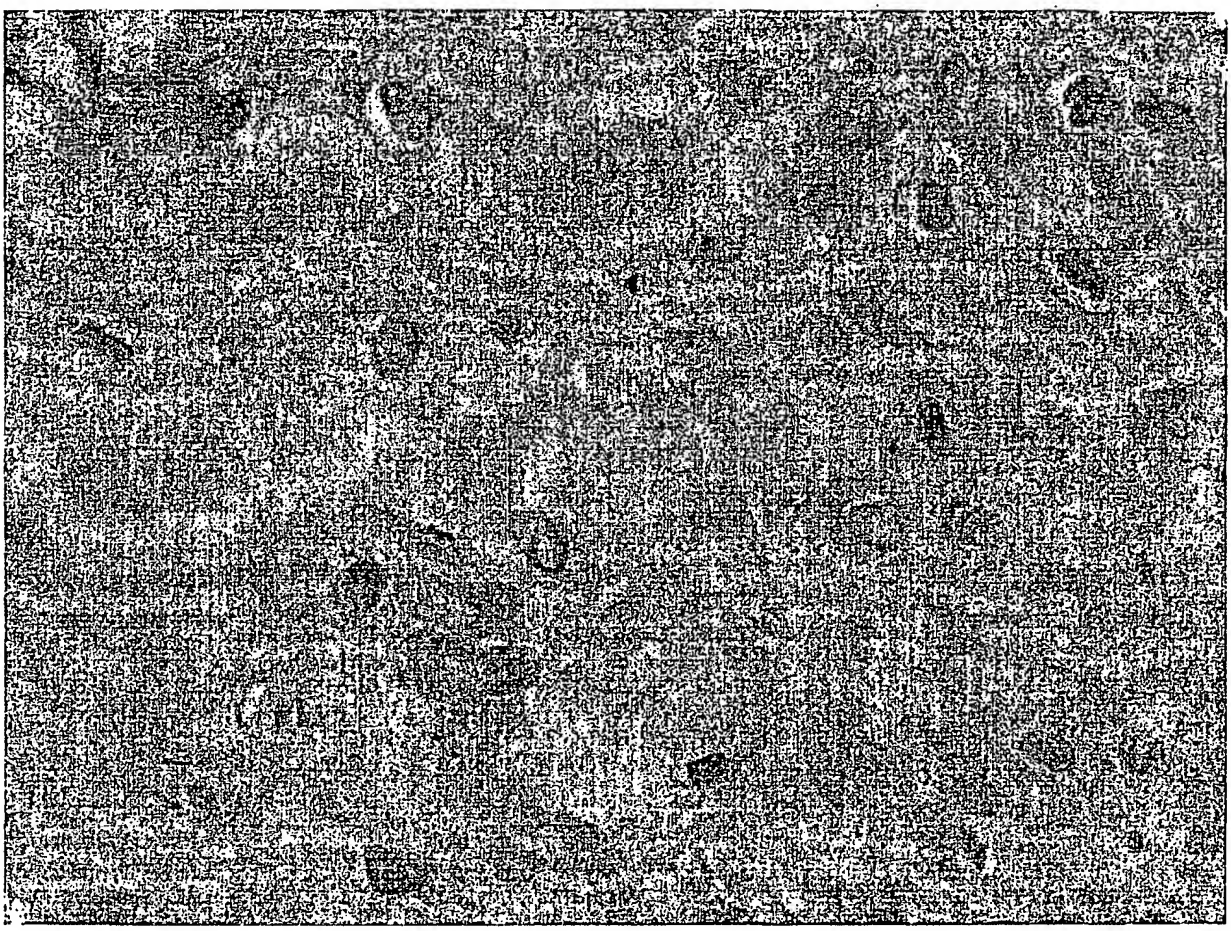
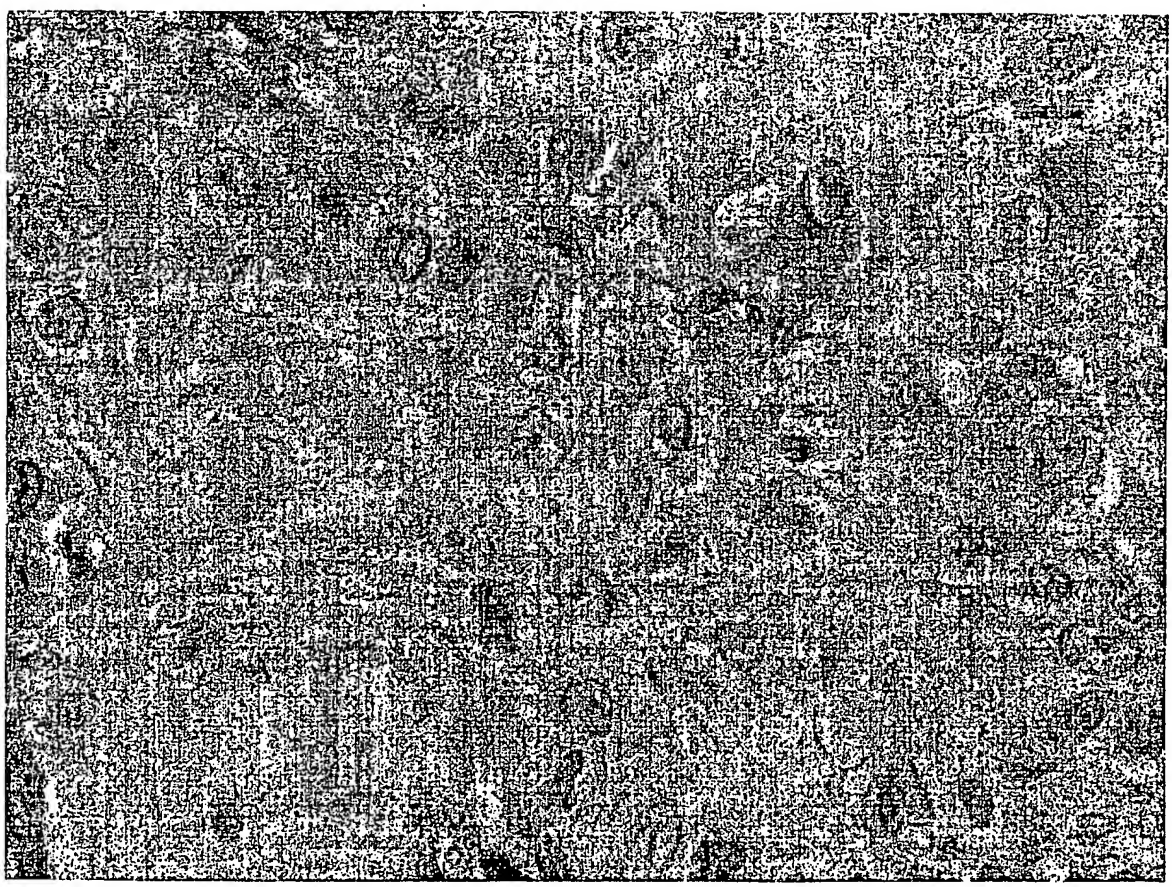
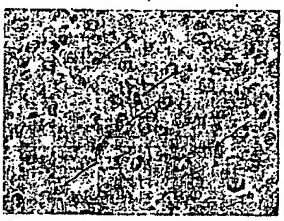


Fig. 96



The parameter "Hergsay_Density" gives some information about the nucleus grylist. The Carcinoma image have big variance of optical density then the normal image. The arrow point up on the nucleus with hi value of Hergsay_Density.

The arrows are pointing up on a normal nucleus with low value of Hergsay_Density.



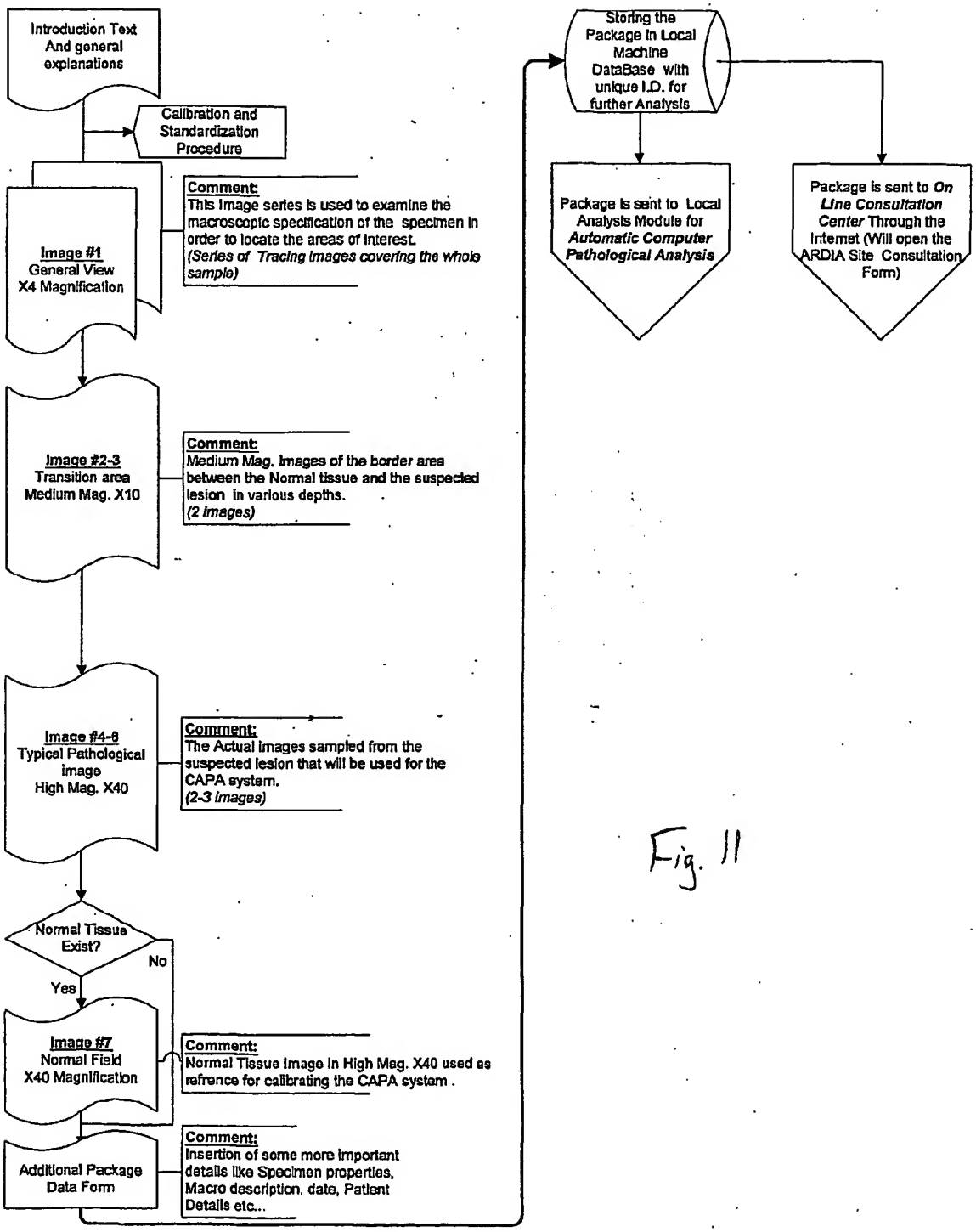

Introduction Text And general explanations
Calibration and Standardization Procedure
Image #1 General View X4 Magnification
Comment: This Image series is used to examine the macroscopic specification of the specimen in order to locate the areas of interest. (Series of Tracing images covering the whole sample)
Image #2-3 Transition area Medium Mag. X10
Comment: Medium Mag. Images of the border area between the Normal tissue and the suspected lesion in various depths. (2 images)
Image #4-6 Typical Pathological Image High Mag. X40
Comment: The Actual Images sampled from the suspected lesion that will be used for the CAPA system. (2-3 images)
Normal Tissue Exist?
No
Yes
Image #7 Normal Field X40 Magnification
Comment: Normal Tissue Image in High Mag. X40 used as refrence for calibrating the CAPA system .
Additional Package Data Form
Comment: Insertion of some more important details like Specimen properties, Macro description, date, Patient Details etc...
Storing the Package in Local Machine DataBase with unique I.D. for further Analysis
Package is sent to Local Analysis Module for Automatic Computer Pathological Analysis
Package is sent to On Line Consultation Center Through the Internet (Will open the ARDIA Site Consultation Form)

Fig. 11

FIG. 12 (1)

Statistics					Mean	Stdv	MinVal	MaxVal	Range	Sum
numobjs =	101	CalibrationX	0.266663	Area	22.90099	19.67156	5.289754	128.1244	122.8346	2313
numobjs =	89	CalibrationX	0.266663	Area	40.69777	28.19518	5.137487	127.3609	122.2234	3639.902
numobjs =	84	CalibrationX	0.266663	Area	51.43524	42.87299	5.07803	176.1545	171.0765	4320.56
numobjs =	141	CalibrationX	0.266663	Area	30.39151	24.33574	5.103082	132.0135	126.9104	4285.202
numobjs =	200	CalibrationX	0.266663	Area	21.07582	14.64956	5.126027	141.7534	136.6274	4362.695
numobjs =	40	CalibrationX	0.266663	Area	42.0936	35.24054	5.021716	129.7951	124.7734	1683.744
numobjs =	44	CalibrationX	0.266663	Area	22.25743	18.41	5.12601	72.86246	67.73646	979.3268
numobjs =	66	CalibrationX	0.266663	Area	21.86518	19.72779	5.077	84.08484	78.98763	1443.102
numobjs =	54	CalibrationX	0.266663	Area	31.99969	23.11354	5.393005	101.4952	96.1022	1727.983
numobjs =	140	CalibrationX	0.266663	Area	23.06355	12.68963	5.087445	73.90853	68.82108	3228.898
numobjs =	147	CalibrationX	0.266663	Area	35.47772	19.68518	5.895699	145.1513	139.2556	5215.225
numobjs =	36	CalibrationX	0.266663	Area	33.78808	19.8488	5.091608	82.47517	77.38356	1216.371
numobjs =	30	CalibrationX	0.266663	Area	14.15152	8.297034	5.457664	42.57254	37.11488	424.5457
numobjs =	55	CalibrationX	0.266663	Area	42.38591	27.62168	5.218844	128.8565	123.6376	2331.225
numobjs =	166	CalibrationX	0.266663	Area	35.52079	18.83666	5.38154	98.98904	93.60751	5896.451
numobjs =	55	CalibrationX	0.266663	Area	35.29058	19.08759	5.689201	79.37659	73.68739	1940.982
numobjs =	54	CalibrationX	0.266663	Area	46.32225	39.45839	5.357574	230.117	224.7594	2501.402
numobjs =	57	CalibrationX	0.266663	Area	33.36891	33.27625	5.972878	146.015	140.0421	1901.914
numobjs =	69	CalibrationX	0.266663	Area	35.5195	34.33121	5.085344	172.1278	167.0424	2450.845
numobjs =	31	CalibrationX	0.266663	Area	35.79173	22.59289	5.17399	86.82523	81.65125	1109.543
numobjs =	87	CalibrationX	0.266663	Area	24.68865	20.41214	5.327311	95.01018	89.68287	2147.913
numobjs =	124	CalibrationX	0.266663	Area	14.12477	10.1576	5.018596	57.98938	52.97078	1751.472
numobjs =	97	CalibrationX	0.266663	Area	25.77094	17.73074	5.108285	82.80672	77.69844	2499.782
numobjs =	186	CalibrationX	0.266663	Area	22.81552	14.37526	5.206317	127.0918	121.8855	4243.688
numobjs =	65	CalibrationX	0.266663	Area	18.73323	26.70049	5.033194	198.1375	193.1043	1217.66
numobjs =	87	CalibrationX	0.266663	Area	39.68764	34.84267	5.154185	179.5806	174.4264	3452.824
numobjs =	30	CalibrationX	0.266663	Area	23.67348	15.0566	5.034231	62.67091	57.63668	710.2043
numobjs		CalibrationX		Area						
Average	86.48148148		0.266663		30.55889	23.00806	5.246149	117.801	112.6548	2555.424
STDev	49.01912529		6.53E-09		9.77477	8.942966	0.253606	46.21016	46.19691	1433.445

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FIG. 12 (2)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Aspect	1.921984	0.617458	1.019637	4.508126	3.48849	194.1204	Density	130.401	7.8197	101.3274	142.1771	40.84966	13170.5
Aspect	1.891266	0.649568	1.03467	3.662052	2.627382	168.3227	Density	125.3249	7.086072	102.8309	137.2789	34.44793	11153.92
Aspect	1.808405	0.675382	1.079491	4.454039	3.374548	151.906	Density	133.8979	3.678896	116.087	139.0016	22.91464	11247.42
Aspect	1.869851	0.716689	1.046894	5.462709	4.415814	263.649	Density	163.446	6.623699	134.5979	174.0976	39.49977	23045.89
Aspect	1.789499	0.833716	1.016511	8.141565	7.125054	370.4264	Density	147.6412	10.8392	126.5546	174.1808	47.62612	30561.73
Aspect	1.750293	0.918938	1.060565	6.279059	5.218494	70.01172	Density	156.7578	9.733992	116.3311	167.5829	51.25179	6270.313
Aspect	1.817248	0.537874	1.064201	3.554824	2.490623	79.95891	Density	152.2225	6.682029	127.7416	163.2064	35.46479	6697.79
Aspect	2.152057	0.888839	1.079289	5.82023	4.740941	142.0358	Density	141.5521	6.00852	116.7023	151.6956	34.99339	9342.436
Aspect	1.587718	0.380547	1.085913	2.846735	1.760822	85.73677	Density	151.9538	10.53909	123.2697	175.6692	52.39952	8205.506
Aspect	1.938233	0.737612	1.012688	5.374916	4.362228	271.3527	Density	134.1003	12.61152	91.25523	148.5686	57.3134	18774.04
Aspect	1.595837	0.494377	1.037136	3.472329	2.435193	234.5881	Density	135.8981	9.658916	103.1395	154.1607	51.02119	19977.03
Aspect	1.934046	0.798889	1.111567	5.321135	4.209568	69.62566	Density	104.4204	9.266604	89.36914	122.4122	33.04305	3759.133
Aspect	2.538979	1.419984	1.098118	8.070826	6.972707	76.16936	Density	142.4899	10.75236	109.2992	156.9861	47.6869	4274.695
Aspect	1.640176	0.609686	1.058928	3.852203	2.793278	90.20969	Density	180.7092	5.603266	161.575	191.4109	29.83591	9939.008
Aspect	1.684568	0.462128	1.083287	3.247506	2.164219	279.6383	Density	147.5026	7.605792	123.9031	161.7598	37.85672	24485.44
Aspect	1.430138	0.553773	1.026067	4.720592	3.694525	78.65761	Density	174.1743	2.95217	165.2047	179.0269	13.82219	9579.587
Aspect	2.152709	1.000031	1.147895	6.577135	5.429239	116.2463	Density	156.8829	7.236906	135.5212	169.3896	33.86835	8471.675
Aspect	2.466447	1.109022	1.080347	5.919497	4.83915	140.5875	Density	148.8988	10.64542	112.2922	163.561	51.26874	8487.233
Aspect	1.973378	0.732212	1.192514	4.498697	3.306184	136.1631	Density	154.8411	8.728325	128.3501	165.6905	37.34038	10684.04
Aspect	1.967456	0.546014	1.062003	3.010179	1.948177	60.99112	Density	158.1606	13.29007	118.0057	179.129	61.1233	4902.979
Aspect	1.816572	0.65863	1.07186	3.721127	2.649267	158.0418	Density	163.8169	11.33341	130.8924	179.9341	49.04167	14252.07
Aspect	2.270422	1.030159	1.085482	5.659025	4.593563	281.5323	Density	139.3938	9.614365	108.1837	153.8435	47.65982	17284.83
Aspect	2.021886	0.876915	1.00257	5.530929	4.528359	196.123	Density	140.3422	10.27598	116.3184	162.404	46.08563	13613.19
Aspect	2.005769	0.754802	1.042949	4.959665	3.916716	373.0729	Density	170.7449	12.25168	132.2941	187.6308	55.33652	31758.55
Aspect	2.514381	1.074504	1.119637	5.641734	4.522097	163.4348	Density	164.9315	8.096376	141.3466	177.7928	36.44623	10720.54
Aspect	2.005748	0.709074	1.106415	3.958986	2.852571	174.5001	Density	170.7402	8.416965	143.7331	188.858	45.12497	14854.39
Aspect	2.060322	0.693897	1.144659	3.48006	2.335401	61.80965	Density	174.2563	8.531158	153.7009	186.1865	32.48561	5227.688
Aspect							Density						
	1.946346	0.756545	1.072269	4.879477	3.807208	166.256		150.5741	8.736388	123.2528	164.9494	41.6966	12990.43
	0.275025	0.229794	0.044987	1.403733	1.406573	91.68714		17.41118	2.542897	19.29279	17.40108	10.88029	7561.963

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FIG. 12 (3)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
DensityStd	8.460812	3.67282	3.680747	25.94936	22.26881	856.562	Perimeter	33.58657	16.4075	11.41555	76.66033	65.24478	3392.244
DensityStd	10.47045	4.794799	3.185071	29.50127	26.3162	931.6698	Perimeter	39.46296	16.38342	13.187	96.93747	83.75047	3512.204
DensityStd	6.267395	2.930731	2.07202	16.83472	14.5627	526.4612	Perimeter	48.71195	26.03694	12.1425	140.1344	127.9919	4091.804
DensityStd	9.914118	4.692311	2.900355	23.65543	20.75508	1397.891	Perimeter	43.62941	24.42337	10.7295	132.9524	122.2229	6151.746
DensityStd	15.75771	5.449222	4.496816	28.68506	24.18824	3261.845	Perimeter	24.09635	14.53829	10.85235	160.8994	150.047	4987.944
DensityStd	10.56202	5.375628	3.230516	27.53876	24.30824	422.4807	Perimeter	47.78776	23.61358	14.05563	116.0842	102.0285	1911.51
DensityStd	9.065822	3.579105	3.631325	18.45796	14.82663	398.8961	Perimeter	30.52875	10.8118	12.65368	54.78398	42.1303	1343.265
DensityStd	8.923961	3.353014	3.100112	18.4784	15.37828	588.9814	Perimeter	32.93803	16.44495	9.823289	88.06039	78.23711	2173.91
DensityStd	10.3929	4.656874	3.109791	22.65991	19.55012	561.2164	Perimeter	36.23063	17.84145	12.35163	75.99177	63.64014	1956.454
DensityStd	10.19968	5.224357	3.91844	30.28203	26.36359	1427.956	Perimeter	24.98537	9.30339	9.330935	65.05534	55.7244	3497.952
DensityStd	11.41359	4.212894	4.196047	28.85507	24.65902	1677.798	Perimeter	28.89016	12.21599	12.00861	112.8344	100.8258	4246.853
DensityStd	10.8755	4.33101	2.328746	20.73903	18.41028	391.518	Perimeter	29.75492	11.16331	15.24174	65.93835	50.6966	1071.177
DensityStd	11.19308	5.115623	4.878406	25.30819	20.42978	335.7924	Perimeter	24.14112	9.269392	11.41554	49.5139	38.09835	724.2338
DensityStd	9.33662	4.526934	2.4224	19.72714	17.30474	513.5141	Perimeter	43.23205	15.47812	16.68128	97.63368	80.9524	2377.763
DensityStd	9.477305	2.846753	3.88289	20.09369	16.2108	1573.233	Perimeter	31.9636	12.96566	10.86007	89.3071	78.44702	5305.958
DensityStd	7.425065	3.239301	2.317015	14.24828	11.93127	408.3786	Perimeter	33.29846	11.51263	14.2758	68.50095	54.22515	1831.415
DensityStd	10.42445	4.95437	3.719014	22.67699	18.95797	562.92	Perimeter	49.57145	40.2707	15.76397	290.3659	274.6019	2676.858
DensityStd	10.89947	5.828033	2.449708	24.39486	21.94515	621.2699	Perimeter	46.33813	35.45489	10.56135	160.7577	150.1964	2641.274
DensityStd	10.35356	5.882214	2.243464	24.45332	22.20986	714.3953	Perimeter	39.36617	30.50425	12.29961	163.4822	151.1826	2716.266
DensityStd	10.76413	5.441933	2.643426	24.03515	21.39173	333.6881	Perimeter	38.39289	17.01427	18.92633	89.81746	70.89113	1190.18
DensityStd	9.228016	6.032238	2.043407	26.34498	24.30156	802.8374	Perimeter	33.65576	18.38981	12.51979	87.88224	75.36246	2928.051
DensityStd	12.38614	4.84537	4.163635	27.56367	23.40004	1535.882	Perimeter	28.3571	15.02994	10.34889	87.16956	76.82067	3516.281
DensityStd	11.31399	5.730178	2.871138	23.63525	20.76411	1097.457	Perimeter	27.55087	11.79426	11.01279	71.78608	60.77329	2672.434
DensityStd	10.29052	5.808203	3.298618	31.63527	28.33666	1914.037	Perimeter	26.82544	11.93879	11.3934	119.8352	108.4418	4988.532
DensityStd	11.36129	5.515103	3.003025	22.71268	19.70966	738.4839	Perimeter	32.02331	18.0548	10.78152	85.66782	74.8863	2081.515
DensityStd	10.50072	5.659982	2.913641	25.47862	22.56498	913.5627	Perimeter	43.08728	26.12035	13.72033	192.9003	179.18	3748.593
DensityStd	8.147593	3.291277	3.688191	16.13749	12.4493	244.4278	Perimeter	31.66923	11.68376	11.97102	62.43978	50.46877	950.0769
DensityStd							Perimeter						
	10.20096	4.710751	3.199554	23.69935	20.4998	916.7909		35.18799	17.95058	12.45645	107.533	95.0766	2914.352
	1.731342	0.993534	0.764998	4.522841	4.296751	663.3286		7.794509	7.996227	2.219182	52.06076	51.69247	1418.306

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FIG. 12 (4)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Roundness	5.35053	3.684233	1.265108	22.03694	20.77183	540.4035	FractaDim	1.161507	6.68E-02	1.057541	1.393093	0.335552	117.3122
Roundness	4.069376	2.627456	1.366325	13.84171	12.47538	362.1745	FractaDim	1.155043	6.39E-02	1.0557	1.352561	0.296861	102.7988
Roundness	4.864732	3.083538	1.511789	19.24262	17.73083	408.6375	FractaDim	1.192604	7.07E-02	1.070213	1.388587	0.318374	100.1787
Roundness	6.166844	4.057281	1.462674	21.81369	20.35102	869.525	FractaDim	1.203579	7.89E-02	1.056249	1.422583	0.366334	169.7047
Roundness	2.508409	1.922835	1.173335	14.53334	13.36	519.2407	FractaDim	1.11868	4.95E-02	1.045084	1.309032	0.263948	231.5668
Roundness	5.978628	3.288685	1.508273	15.98725	14.47898	239.1451	FractaDim	1.239217	9.48E-02	1.066208	1.449118	0.382911	49.56868
Roundness	4.692498	2.664065	1.257772	13.77752	12.51975	206.4699	FractaDim	1.173547	6.57E-02	1.062893	1.338077	0.275184	51.63605
Roundness	4.904777	2.536925	1.440033	12.75301	11.31298	323.7153	FractaDim	1.174217	6.01E-02	1.071919	1.35624	0.284322	77.4983
Roundness	4.190154	2.662797	1.291875	11.91268	10.62081	226.2683	FractaDim	1.18087	7.90E-02	1.061165	1.485073	0.423908	63.76698
Roundness	2.494027	1.426229	1.214976	8.966422	7.751446	349.1638	FractaDim	1.117272	5.47E-02	1.053304	1.362804	0.3095	156.418
Roundness	2.065054	0.895016	1.223479	6.979953	5.756474	303.5629	FractaDim	1.111716	4.45E-02	1.051162	1.288264	0.237102	163.4222
Roundness	2.588655	1.470031	1.273981	8.123541	6.84956	93.19157	FractaDim	1.124929	7.00E-02	1.051486	1.332002	0.280516	40.49745
Roundness	3.768175	2.167356	1.371854	11.73103	10.35918	113.0452	FractaDim	1.157964	0.063313	1.055993	1.30495	0.248957	34.73893
Roundness	4.59733	2.807206	1.682816	14.52093	12.83812	252.8531	FractaDim	1.186891	6.44E-02	1.072251	1.302497	0.230246	65.27903
Roundness	2.649153	1.393801	1.257278	9.90887	8.651591	439.7595	FractaDim	1.137059	5.83E-02	1.05134	1.363864	0.312524	188.7519
Roundness	3.258556	2.107156	1.35562	11.4722	10.11658	179.2208	FractaDim	1.153059	5.89E-02	1.075548	1.310254	0.234705	63.41822
Roundness	5.495781	4.618794	1.361379	29.15631	27.79494	296.7711	FractaDim	1.191595	8.13E-02	1.067896	1.385813	0.317917	64.34614
Roundness	6.045545	4.261816	1.376219	18.84931	17.47309	344.596	FractaDim	1.172601	7.33E-02	1.052024	1.307217	0.255193	66.83826
Roundness	4.712458	3.85071	1.271571	17.00653	15.73496	325.1596	FractaDim	1.170544	8.06E-02	1.05732	1.389539	0.332218	80.76751
Roundness	4.332523	3.180293	1.42501	16.74198	15.31697	134.3082	FractaDim	1.162269	6.96E-02	1.050789	1.371444	0.320655	36.03033
Roundness	4.397806	2.487364	1.247589	11.83948	10.59189	382.6091	FractaDim	1.17473	6.83E-02	1.054978	1.343776	0.288799	102.2015
Roundness	5.442535	3.75632	1.187163	17.51004	16.32288	674.8744	FractaDim	1.156101	5.81E-02	1.060601	1.327913	0.267313	143.3565
Roundness	3.044329	1.990604	1.174892	11.6977	10.52281	295.2999	FractaDim	1.124915	5.69E-02	1.051996	1.378798	0.326802	109.1167
Roundness	2.942312	1.767444	1.183136	11.24599	10.06285	547.2701	FractaDim	1.131223	5.98E-02	1.049514	1.362391	0.312877	210.4075
Roundness	5.855034	4.119751	1.192949	17.95317	16.76022	380.5772	FractaDim	1.176788	6.59E-02	1.069394	1.361271	0.291876	76.49124
Roundness	4.760407	3.029383	1.604151	16.58328	14.97913	414.1554	FractaDim	1.181169	6.86E-02	1.072654	1.333104	0.26045	102.7817
Roundness	4.439846	3.286095	1.420341	17.54416	16.12381	133.1954	FractaDim	1.175079	6.99E-02	1.059764	1.347189	0.287426	35.25236
Roundness							FractaDim						
	4.282054	2.763081	1.337096	14.95295	13.61585	346.4886		1.163154	0.066518	1.059444	1.358054	0.29861	100.1528
	1.22334	0.984111	0.135916	4.847667	4.808409	176.3337		0.029571	0.010638	0.00853	0.045667	0.04571	55.58973

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FIG. 12 (5)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Hetrogneity	1.65E-02	4.74E-02	0	0.301084	0.301084	1.665838	Diameter	5.952164	2.234659	2.429187	14.27289	11.8437	601.1686
Hetrogneity	3.92E-02	6.39E-02	0	0.360447	0.360447	3.490931	Diameter	7.393772	2.657649	2.728126	14.87448	12.14635	658.0457
Hetrogneity	4.74E-03	0.01616	0	0.102522	0.102522	0.397999	Diameter	7.831546	3.439886	2.787012	15.36124	12.57423	657.8499
Hetrogneity	4.05E-02	6.65E-02	0	0.369369	0.369369	5.715777	Diameter	6.57637	2.44978	2.646899	13.86329	11.21639	927.2682
Hetrogneity	0.127749	0.123475	0	0.521212	0.521212	26.44405	Diameter	5.311145	1.735179	2.878331	18.08525	13.20692	1099.407
Hetrogneity	5.52E-02	8.80E-02	0	0.442623	0.442623	2.207531	Diameter	7.20812	3.083595	2.764973	12.95509	10.19012	288.3248
Hetrogneity	2.02E-02	3.72E-02	0	0.149837	0.149837	0.888572	Diameter	5.520841	1.96826	2.745715	9.733858	6.988143	242.917
Hetrogneity	1.50E-02	3.27E-02	0	0.197411	0.197411	0.99032	Diameter	5.652023	2.328377	2.847421	11.82635	8.978928	373.0335
Hetrogneity	4.02E-02	7.18E-02	0	0.290909	0.290909	2.169096	Diameter	6.338613	2.343897	2.882579	11.40033	8.51775	342.2851
Hetrogneity	4.37E-02	9.58E-02	0	0.484043	0.484043	6.123356	Diameter	5.543899	1.454417	2.678877	10.6463	7.967426	776.1459
Hetrogneity	4.31E-02	8.03E-02	0	0.479167	0.479167	6.341069	Diameter	6.703836	1.88765	2.95375	14.3118	11.36804	985.4639
Hetrogneity	3.47E-02	5.36E-02	0	0.280952	0.280952	1.248832	Diameter	6.614605	2.038598	2.672497	10.75315	8.080658	238.1258
Hetrogneity	5.09E-02	9.90E-02	0	0.389764	0.389764	1.528196	Diameter	4.756038	1.240992	3.018725	7.422895	4.40417	142.6812
Hetrogneity	3.69E-02	5.14E-02	0	0.195373	0.195373	2.031231	Diameter	7.39494	2.322815	2.939015	13.21145	10.27244	406.7217
Hetrogneity	1.52E-02	3.03E-02	0	0.197719	0.197719	2.53142	Diameter	6.766256	1.987762	2.964254	12.25119	9.28694	1123.199
Hetrogneity	1.20E-02	0.019021	0	0.06875	0.06875	0.657669	Diameter	6.613416	1.955845	2.98835	10.45104	7.462692	363.7379
Hetrogneity	4.87E-02	6.36E-02	0	0.240964	0.240964	2.628734	Diameter	7.650801	3.319113	2.887782	21.61998	18.73219	413.1432
Hetrogneity	5.73E-02	9.36E-02	0	0.323333	0.323333	3.265184	Diameter	7.069453	3.456632	2.841816	16.15178	13.30996	402.9588
Hetrogneity	5.16E-02	8.57E-02	0	0.43633	0.43633	3.561627	Diameter	6.772191	3.148992	2.767015	19.0716	16.30459	467.2812
Hetrogneity	5.43E-02	8.76E-02	0	0.358396	0.358396	1.684172	Diameter	6.878447	2.191786	3.521065	10.97619	7.455128	213.2319
Hetrogneity	4.89E-02	0.10576	0	0.481482	0.481482	4.255739	Diameter	5.691257	2.161973	2.867933	11.0795	8.211573	495.1394
Hetrogneity	6.48E-02	9.14E-02	0	0.424242	0.424242	8.038167	Diameter	5.02722	1.809832	2.563457	10.91837	8.35491	623.3753
Hetrogneity	6.07E-02	8.54E-02	0	0.3125	0.3125	5.891216	Diameter	5.872742	1.904885	2.848174	10.75318	7.905006	569.6559
Hetrogneity	4.96E-02	0.1124	0	0.555901	0.555901	9.224569	Diameter	5.642164	1.643963	2.499109	14.17832	11.67921	1030.843
Hetrogneity	0.056083	8.09E-02	0	0.337748	0.337748	3.645401	Diameter	5.698911	2.79637	2.642659	16.54044	13.89778	370.4292
Hetrogneity	5.25E-02	9.65E-02	0	0.471264	0.471264	4.56347	Diameter	7.094466	2.99605	2.616754	16.07713	13.46038	617.2186
Hetrogneity	1.25E-02	2.49E-02	0	0.108434	0.108434	0.376241	Diameter	5.833878	1.73571	2.710641	9.733197	7.022556	175.0163
Hetrogneity							Diameter						
	0.042704	0.070524	0	0.328955	0.328955	4.132089		6.344782	2.306469	2.803412	13.20446	10.40104	540.9136
	0.0242	0.029927	0	0.136443	0.136443	5.037787		0.836193	0.614156	0.207527	3.145804	3.192367	288.9508

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FIG. 12 (6)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Angle	101.3226	48.06218	2.874417	179.5708	176.6984	10233.58	Silhouette	0.303196	0.919004	0	5.525053	5.525053	30.62284
Angle	94.74939	65.36829	4.355707	179.5639	175.2082	8432.696	Silhouette	1.142377	5.133015	0	42.80729	42.80729	101.6715
Angle	109.0672	53.07389	0.217208	176.8209	176.6037	9161.648	Silhouette	2.879249	6.112285	0	34.47963	34.47963	241.8569
Angle	99.79768	62.68732	5.04E-02	179.9049	179.8545	14071.47	Silhouette	0.487435	2.245928	0	15.56737	15.56737	68.72834
Angle	94.40742	49.57016	1.010329	177.8221	176.8118	19542.33	Silhouette	1.771989	6.661211	0	54.274	54.274	354.3978
Angle	71.97641	49.69487	4.359511	172.5896	168.2301	2879.056	Silhouette	18.63277	19.30039	0	68.7636	68.7636	745.3108
Angle	89.05077	46.38492	11.14875	174.8855	163.7367	3918.234	Silhouette	5.148859	10.51923	0	35.95776	35.95776	226.5498
Angle	87.08849	59.13424	2.945683	173.6851	170.7394	5747.841	Silhouette	5.748097	13.04077	0	69.73818	69.73818	379.3744
Angle	101.5281	57.53654	1.200802	178.0193	176.8185	5482.515	Silhouette	1.024621	3.576069	0	23.03831	23.03831	55.32951
Angle	109.3313	56.36274	1.48E-03	179.0706	179.0691	15306.38	Silhouette	4.603386	10.19396	0	46.20755	46.20755	644.4741
Angle	98.89318	47.79143	0.963522	179.0269	178.0634	14537.3	Silhouette	5.007339	10.2542	0	54.59249	54.59249	736.0789
Angle	70.73966	44.34607	8.604548	170.9812	162.3767	2546.628	Silhouette	3.598742	10.2457	0	43.24716	43.24716	129.5547
Angle	115.0679	63.14429	0.682104	179.3641	178.682	3452.036	Silhouette	1.346017	2.362019	0	7.327334	7.327334	40.3805
Angle	122.0154	41.95021	14.42292	176.2808	161.8579	6710.844	Silhouette	2.488931	6.518048	0	42.60087	42.60087	137.4412
Angle	81.54896	48.08735	0.320104	179.6594	179.3393	13537.13	Silhouette	3.578707	7.565881	0	53.99193	53.99193	594.0654
Angle	64.98574	47.06758	2.046721	178.5841	176.5374	3574.216	Silhouette	0.717232	1.738511	0	9.307412	9.307412	39.44778
Angle	57.39436	59.57972	1.767824	179.0564	177.2886	3099.295	Silhouette	1.200868	2.736958	0	12.19518	12.19518	64.84686
Angle	51.20594	43.15832	1.989607	174.1694	172.1798	2918.738	Silhouette	3.502175	7.568346	0	30.89087	30.89087	199.624
Angle	75.47993	52.06059	0.396958	178.6191	178.2222	5208.116	Silhouette	2.859518	8.680221	0	39.73629	39.73629	197.3068
Angle	132.044	56.7278	4.91443	177.8432	172.9288	4093.365	Silhouette	2.075577	8.820435	0	49.40678	49.40678	64.3429
Angle	72.34659	50.84815	0.868104	178.2628	177.3947	6294.153	Silhouette	2.974604	9.804873	0	63.62767	63.62767	258.7905
Angle	71.78721	50.49477	4.952584	178.8518	173.8992	8901.613	Silhouette	1.59828	7.064458	0	50.68131	50.68131	198.1867
Angle	90.3145	68.96404	0.340964	179.6803	179.3394	8760.506	Silhouette	3.76644	8.549916	0	46.87665	46.87665	365.3447
Angle	109.7126	34.14442	7.286486	178.8284	171.5419	20406.55	Silhouette	3.661636	8.420924	0	44.96852	44.96852	681.0643
Angle	96.48721	54.92768	2.509104	179.4312	176.9221	6271.669	Silhouette	3.427473	10.94345	0	59.99883	59.99883	222.7857
Angle	103.7873	57.80362	2.661479	179.4186	176.7581	9029.499	Silhouette	4.701001	13.18105	0	62.01895	62.01895	408.9871
Angle	73.24893	48.556	0.970584	175.6347	174.6641	2197.468	Silhouette	3.218649	10.71516	0	45.53843	45.53843	96.55946
Angle							Silhouette						
	90.56958	52.50101	3.106013	177.6158	174.5098	8011.662		3.367969	7.884149	0	41.23576	41.23576	269.7453
	19.95554	7.868046	3.579832	2.426651	5.133817	5182.03		3.402034	4.115253	0	18.68835	18.68835	228.3018

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FIG. 12 (7)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Dens*Aspect	298.1584	141.3298	138.6324	1129.38	990.748	30114	HetrDnsity	0.980773	4.827801	0	42.80729	42.80729	99.05811
Dens*Aspect	258.325	104.1013	131.9406	636.0776	504.1371	22990.92	HetrDnsity	2.940962	6.122161	0	34.47983	34.47983	261.7456
Dens*Aspect	266.9062	104.2732	151.7597	591.5497	439.79	22420.12	HetrDnsity	0.13641	0.913518	0	8.129479	8.129479	11.45844
Dens*Aspect	373.3922	171.278	178.6193	1318.055	1139.436	52648.3	HetrDnsity	2.485085	7.804804	0	54.274	54.274	350.397
Dens*Aspect	374.5287	263.1655	138.5392	2061.57	1923.03	74905.73	HetrDnsity	10.11397	15.42491	0	69.73818	69.73818	2022.794
Dens*Aspect	502.4055	301.31	181.2306	1373.334	1192.104	20096.22	HetrDnsity	3.731413	8.375675	0	34.41068	34.41068	149.2565
Dens*Aspect	390.1198	547.9439	169.4974	3901.372	3731.874	17165.27	HetrDnsity	1.425518	3.997805	0	22.49284	22.49284	62.72278
Dens*Aspect	354.0111	154.4522	146.3749	822.5203	676.1454	23364.73	HetrDnsity	0.700877	3.022323	0	23.03831	23.03831	46.25791
Dens*Aspect	310.2231	120.9703	168.3349	662.0105	493.6757	16752.05	HetrDnsity	1.803832	5.718543	0	35.86028	35.86028	97.40691
Dens*Aspect	285.0765	146.8245	118.5355	1182.632	1064.096	39910.71	HetrDnsity	4.827848	10.27582	0	54.69249	54.69249	676.8987
Dens*Aspect	240.8273	102.2615	139.2481	983.1857	843.9376	35401.62	HetrDnsity	4.078647	8.64987	0	53.99193	53.99193	699.5611
Dens*Aspect	215.6878	83.08624	141.141	561.2217	420.0807	7764.76	HetrDnsity	1.380378	2.587726	0	9.971412	9.971412	49.6936
Dens*Aspect	381.5004	210.9806	155.0855	1070.166	915.0802	11445.01	HetrDnsity	3.595428	10.07737	0	42.60087	42.60087	107.8628
Dens*Aspect	444.5918	272.5957	197.5606	1212.811	1015.25	24452.55	HetrDnsity	1.203055	3.699394	0	21.97462	21.97462	66.16804
Dens*Aspect	282.5047	107.2777	160.2249	911.8823	751.6575	48895.78	HetrDnsity	0.793349	1.950992	0	13.21132	13.21132	131.6959
Dens*Aspect	266.5388	115.4129	176.6842	965.0224	788.3383	14659.63	HetrDnsity	1.112715	2.640811	0	12.19518	12.19518	61.19931
Dens*Aspect	398.6898	247.4799	191.8251	1504.883	1313.058	21529.25	HetrDnsity	3.390753	7.701402	0	30.89087	30.89087	183.1007
Dens*Aspect	368.2472	172.8679	164.9031	986.5908	821.6877	20990.09	HetrDnsity	3.443177	9.444908	0	39.73629	39.73629	196.2611
Dens*Aspect	384.6277	160.0005	195.0898	1001.587	806.4975	26539.31	HetrDnsity	1.434846	5.538783	0	33.17203	33.17203	99.00439
Dens*Aspect	472.2314	258.9441	157.4845	1217.523	1060.038	14639.17	HetrDnsity	3.041434	9.082381	0	35.50663	35.50663	94.28444
Dens*Aspect	365.6997	212.3167	176.3689	1755.668	1579.299	31815.87	HetrDnsity	2.437169	9.521434	0	50.68131	50.68131	212.0337
Dens*Aspect	377.3735	198.4144	148.4744	1616.675	1468.201	46794.32	HetrDnsity	3.964371	9.085096	0	46.87665	46.87665	491.582
Dens*Aspect	346.7209	167.9897	118.1072	1029.715	911.6083	33631.93	HetrDnsity	3.451968	7.864158	0	38.8139	38.8139	334.8409
Dens*Aspect	349.0739	210.8111	157.6629	2097.72	1940.057	64927.75	HetrDnsity	3.492986	11.31225	0	63.1866	63.1866	649.6955
Dens*Aspect	421.1819	235.4189	180.0457	1264.869	1084.823	27376.82	HetrDnsity	2.575481	8.217033	0	47.73957	47.73957	167.4063
Dens*Aspect	480.3957	310.7846	181.0808	1833.681	1652.6	41794.42	HetrDnsity	2.841386	8.136056	0	45.53843	45.53843	247.2006
Dens*Aspect	369.8069	126.4656	201.444	616.717	415.2731	11094.21	HetrDnsity	0.481906	1.614401	0	6.682646	6.682646	14.45718
Dens*Aspect							HetrDnsity						
	354.7721	194.3984	161.6998	1270.682	1108.982	29708.17		2.661694	6.796571	0	35.94791	35.94791	277.1498
	74.13952	96.25827	23.25084	677.2672	674.8981	16474.39		1.960949	3.473188	0	17.02252	17.02252	397.7649

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Statistics					Mean	Stdv	MinVal	MaxVal	Range	Sum
numobjs =	99	Calibration.	0.266663	Area	29.60374	28.93454	5.522344	122.7366	117.2142	2930.771
numobjs =	54	Calibration.	0.266663	Area	35.07679	36.49937	5.124964	204.6423	199.5173	1894.146
numobjs =	54	Calibration.	0.266663	Area	36.83681	33.53144	5.03841	122.8586	117.8202	1989.188
numobjs =	111	Calibration.	0.266663	Area	28.72077	15.09586	5.453504	67.28172	61.82822	3188.006
numobjs =	44	Calibration.	0.266663	Area	39.67408	26.91381	7.274457	108.2742	100.9998	1745.66
numobjs =	77	Calibration.	0.266663	Area	25.13723	15.70475	5.203197	72.43488	67.23169	1935.567
numobjs =	103	Calibration.	0.266663	Area	33.06004	20.81338	5.209445	79.56953	74.36008	3405.185
numobjs =	65	Calibration.	0.266663	Area	28.86703	16.26071	5.063434	72.99699	67.93356	1876.357
numobjs =	74	Calibration.	0.266663	Area	39.61375	21.48274	7.519544	101.3356	93.81604	2931.418
numobjs =	68	Calibration.	0.266663	Area	18.24127	9.894116	5.183378	45.0057	39.82232	1240.406
numobjs =	137	Calibration.	0.266663	Area	34.52176	18.93323	5.472271	106.5356	101.0633	4729.481
numobjs =	60	Calibration.	0.266663	Area	61.47082	49.06849	5.218833	304.4572	299.2384	3688.249
numobjs =	99	Calibration.	0.266663	Area	36.3848	27.02183	5.252211	107.4368	102.1845	3602.095
numobjs =	73	Calibration.	0.266663	Area	23.3131	21.78066	5.058226	105.6533	100.5951	1701.856
numobjs =	82	Calibration.	0.266663	Area	22.66491	13.20195	5.03006	59.88523	54.85517	1858.523
numobjs =	69	Calibration.	0.266663	Area	32.07402	30.69463	5.195884	121.629	116.4331	2213.107
numobjs =	107	Calibration.	0.266663	Area	29.31329	15.00214	5.001922	67.3005	62.29858	3136.522
numobjs =	64	Calibration.	0.266663	Area	32.73479	12.62279	5.464973	60.73416	55.26918	2095.027
numobjs =	100	Calibration.	0.266663	Area	35.16245	25.5456	5.19176	142.5607	137.369	3516.245
numobjs =	76	Calibration.	0.266663	Area	28.96635	17.25444	5.313748	75.27891	69.96516	2201.442
numobjs =	85	Calibration.	0.266663	Area	52.90242	61.17258	5.00399	397.3826	392.3786	4496.706
numobjs =	69	Calibration.	0.266663	Area	34.44584	17.22611	5.050938	70.55647	65.50552	2376.763
numobjs =	93	Calibration.	0.266663	Area	45.16831	35.83546	5.080134	197.6025	192.5223	4200.653
numobjs =	70	Calibration.	0.266663	Area	45.2248	36.55443	5.01756	185.4377	180.4201	3165.736
numobjs =	56	Calibration.	0.266663	Area	23.94299	18.6017	6.058382	129.4196	123.3612	1340.807
numobjs =	104	Calibration.	0.266663	Area	22.9098	13.47453	5.102023	51.85048	46.74845	2382.62
numobjs		CalibrationX		Area						
Average	80.5		0.266663		33.69354	24.58159	5.388677	122.3406	116.952	2686.251
STDev	21.96224		5.16E-09		9.718881	12.07934	0.634993	80.8556	80.92923	966.8

FIG. 12 (8)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Aspect	1.92014	0.768696	1.030286	5.011872	3.981586	190.0938	Density	116.1737	7.345974	85.81216	130.9351	45.12294	11501.2
Aspect	2.087044	0.808578	1.173413	5.599463	4.42605	112.7004	Density	98.54554	7.437002	72.36691	113.1791	40.81216	5321.459
Aspect	1.778977	0.621484	1.100217	3.522861	2.422644	96.06474	Density	155.3277	5.426143	123.486	161.1034	37.61737	8387.696
Aspect	1.718247	0.5145	1.073819	3.728278	2.654459	190.7254	Density	150.1671	6.631248	134.4227	162.2517	27.82895	16668.55
Aspect	1.841267	0.991755	1.151492	7.377127	6.225636	81.01577	Density	175.4417	4.442077	161.6149	181.6375	20.02257	7719.435
Aspect	1.693699	0.472505	1.053304	3.494637	2.441333	130.4149	Density	132.3575	4.660735	107.01	138.6107	31.60072	10191.53
Aspect	1.59576	0.39098	1.018096	2.691067	1.67297	164.3633	Density	128.29	8.047766	85.95096	139.7068	53.75587	13213.87
Aspect	1.641488	0.508142	1.010073	3.726757	2.716684	106.6967	Density	117.8069	4.566848	103.7085	126.678	22.96952	7657.446
Aspect	1.444202	0.316116	1.010243	2.480166	1.469922	106.871	Density	116.1127	5.678846	92.6804	124.2426	31.66221	8592.343
Aspect	2.003854	0.629493	1.039326	4.27095	3.231624	136.262	Density	103.9799	8.84719	78.25352	117.066	38.81246	7070.635
Aspect	1.732075	0.462634	1.110208	3.188694	2.078486	237.2943	Density	115.0741	7.890092	85.44683	126.8756	41.42876	15765.16
Aspect	1.570379	0.487318	1.020783	3.395774	2.375011	94.22276	Density	154.7083	2.740381	146.3024	161.1722	14.8698	9282.5
Aspect	2.30058	1.09876	1.066176	7.222662	6.156486	227.7574	Density	142.8549	3.667963	134.0967	149.792	15.6953	14142.63
Aspect	1.991	0.718019	1.017914	4.193232	3.175318	145.343	Density	124.9871	7.180308	98.06331	144.8906	46.82726	9124.058
Aspect	1.91139	0.751878	1.091485	6.340069	5.248584	156.734	Density	133.7509	9.885523	104.2458	147.5263	43.28052	10967.58
Aspect	1.979579	0.702965	1.046333	4.655735	3.609402	136.5909	Density	149.9623	7.245183	111.6296	157.3675	45.73789	10347.4
Aspect	1.706505	0.50657	1.050675	3.857359	2.806684	182.596	Density	127.004	10.38574	97.78474	146.0876	48.30286	13589.43
Aspect	1.579501	0.55831	1.037528	4.327383	3.289855	101.0881	Density	128.6436	10.06515	103.204	143.0842	39.88013	8233.188
Aspect	1.616614	0.42953	1.057606	4.05836	3.000754	161.6614	Density	134.8047	7.264224	110.892	147.865	36.97295	13480.47
Aspect	1.984907	0.781737	1.039522	5.153096	4.113575	150.853	Density	139.6692	3.742451	127.4074	145.5385	18.13106	10614.86
Aspect	1.718393	0.554309	1.046149	4.401951	3.355802	146.0634	Density	132.489	3.335407	115.2395	138.0583	22.81886	11261.56
Aspect	1.424507	0.242367	1.032913	2.065052	1.032139	98.29101	Density	126.6856	8.78211	99.65905	138.6913	39.03226	8741.305
Aspect	1.590521	0.491158	1.009435	3.517681	2.508245	147.9184	Density	124.2591	10.58862	91.07143	137.2196	46.14816	11556.1
Aspect	1.873927	0.641904	1.063544	3.996834	2.932289	131.1749	Density	146.0073	9.282277	112.313	158.0665	45.75356	10220.51
Aspect	2.291373	0.810873	1.264449	5.408587	4.144139	128.3169	Density	132.149	6.605105	118.806	143.4763	24.67035	7400.344
Aspect	1.750431	0.52552	1.054923	3.937459	2.882536	182.0448	Density	143.2267	5.599974	118.5027	150.5913	32.08857	14895.58
Aspect							Density						
	1.797937	0.607081	1.064227	4.293158	3.228931	143.9676		132.7107	6.820936	108.4566	143.5275	35.07089	10613.34
	0.228646	0.197367	0.05798	1.302609	1.274854	40.52359		16.94611	2.307264	21.11556	15.24141	11.14347	2902.779

FIG. 12 (9)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
DensityStd	8.882535	3.753532	4.086712	19.51915	15.43244	879.371	Perimeter	39.77371	22.24246	10.45732	111.9359	101.4786	3937.597
DensityStd	7.762331	3.17244	3.972851	17.78733	13.81448	419.1659	Perimeter	42.90374	23.31029	10.88222	117.5182	106.636	2316.802
DensityStd	6.750368	2.805263	3.037297	20.27952	17.24223	364.5199	Perimeter	40.23399	18.94937	12.83626	88.2839	75.44764	2172.636
DensityStd	8.599108	3.373189	3.219367	18.34871	15.12934	954.5009	Perimeter	31.571	11.24649	13.64177	80.2132	66.57143	3504.381
DensityStd	8.451996	3.442543	4.193832	17.8416	13.64777	371.8878	Perimeter	49.11439	18.55105	16.2188	111.2235	95.00476	2161.033
DensityStd	7.448909	2.205059	3.722929	16.82476	13.10183	573.566	Perimeter	33.57107	13.55745	10.3489	74.94748	64.59859	2584.972
DensityStd	10.56439	3.713154	4.570215	23.17822	18.608	1088.132	Perimeter	32.00137	12.28447	13.37511	63.69007	50.31497	3296.141
DensityStd	7.05846	1.703457	3.336006	11.04295	7.706945	458.7999	Perimeter	29.80408	7.818585	15.60139	48.15619	32.55479	1937.266
DensityStd	7.463639	2.910921	4.000142	19.60864	15.6085	552.3241	Perimeter	39.97259	13.45749	17.26682	91.36773	74.1011	2957.972
DensityStd	7.889815	2.388391	4.543854	15.20276	10.6589	536.5074	Perimeter	28.14581	9.275431	13.64177	58.55709	44.91532	1913.915
DensityStd	10.45586	4.234389	3.885008	25.80953	21.92452	1432.452	Perimeter	33.2361	12.9819	13.60086	87.36446	73.7636	4553.345
DensityStd	7.874601	2.86104	3.255654	15.36162	12.10597	472.4761	Perimeter	57.97248	27.86344	16.19665	210.1613	193.9647	3478.349
DensityStd	8.847058	3.826381	3.446682	20.56759	17.12091	875.8588	Perimeter	46.40849	18.27336	13.68274	97.09275	83.41001	4594.44
DensityStd	9.225536	4.221879	4.035817	25.26759	21.23177	673.4641	Perimeter	41.44074	18.90481	12.6725	94.28658	81.61407	3025.174
DensityStd	10.93072	4.45279	4.349683	28.774	24.42432	896.3189	Perimeter	30.77746	11.83912	12.3926	72.86726	60.47467	2523.752
DensityStd	7.091496	4.673335	2.807086	30.47627	27.66919	489.3133	Perimeter	44.33273	23.45186	12.78425	106.386	93.6018	3058.958
DensityStd	10.06803	3.617609	4.38833	18.78556	14.39723	1077.28	Perimeter	29.46367	10.38337	14.891	69.74022	54.84922	3151.542
DensityStd	9.921718	3.765841	3.720101	19.67331	15.9532	634.9899	Perimeter	28.3147	7.448792	15.42433	55.3727	39.94837	1812.141
DensityStd	8.642887	4.372922	3.067275	22.99695	19.92968	864.2886	Perimeter	38.52209	20.42639	12.67582	125.444	112.7682	3852.209
DensityStd	5.730046	1.926895	2.376338	10.55789	8.181557	435.4835	Perimeter	38.5815	13.3269	13.98699	84.36259	70.3756	2932.194
DensityStd	5.116456	1.661674	2.577672	12.48892	9.911247	434.8987	Perimeter	53.84325	35.21814	10.88222	248.6401	237.7579	4576.676
DensityStd	7.602174	2.796007	3.470747	16.76022	13.28947	524.55	Perimeter	33.16311	10.59132	12.7577	62.51832	49.76062	2288.254
DensityStd	9.465218	4.459021	3.469294	25.75225	22.28296	880.2652	Perimeter	39.63507	21.34274	13.31757	145.5001	132.1825	3686.062
DensityStd	8.44565	3.813496	3.775856	21.71492	17.93906	591.1955	Perimeter	54.8037	31.3144	16.96457	192.5552	175.5906	3836.259
DensityStd	7.280212	2.780015	3.394413	15.90929	12.51488	407.6919	Perimeter	30.65441	13.94781	15.5549	116.6972	101.1423	1716.647
DensityStd	6.056311	1.722701	3.929411	12.0175	8.088089	629.8563	Perimeter	31.41851	10.9067	13.27999	62.89454	49.61455	3267.525
DensityStd							Perimeter						
	8.216374	3.255921	3.639714	19.32873	15.68902	673.8138		38.44807	16.88131	13.66673	102.9914	89.32469	3043.702
	1.498533	0.925384	0.583363	5.206291	5.101555	270.8236		8.570109	7.233076	1.916386	48.99012	48.9958	871.1014

FIG. 12(10)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Roundnes	5.666899	3.56037	1.362343	21.10268	19.74034	561.023	FractaDim	1.206024	7.17E-02	1.060571	1.391303	0.330732	119.3964
Roundnes	5.421129	3.303999	1.348679	15.75105	14.40237	292.741	FractaDim	1.196682	6.82E-02	1.071818	1.38445	0.312632	64.62085
Roundnes	4.865941	2.378039	1.487757	14.65858	13.17082	262.7608	FractaDim	1.211585	7.56E-02	1.057751	1.392594	0.334843	65.4256
Roundnes	3.290721	1.777616	1.501526	10.66132	9.159799	365.27	FractaDim	1.162223	6.34E-02	1.061699	1.380814	0.319115	129.0067
Roundnes	6.783232	3.995873	1.480863	18.48447	17.0036	298.4622	FractaDim	1.215937	7.72E-02	1.076246	1.394609	0.318363	53.50123
Roundnes	4.133936	1.950004	1.334047	13.27194	11.93789	318.3131	FractaDim	1.193587	6.77E-02	1.072122	1.378572	0.306451	91.90617
Roundnes	3.320485	2.30841	1.269548	11.22586	9.956307	342.01	FractaDim	1.15398	6.93E-02	1.061014	1.383044	0.322029	118.8599
Roundnes	3.064625	1.551823	1.483086	7.852293	6.369207	199.2006	FractaDim	1.159448	6.47E-02	1.073215	1.360071	0.286856	75.36414
Roundnes	3.936598	2.179057	1.482225	12.13754	10.65532	291.3083	FractaDim	1.183078	8.19E-02	1.068555	1.423563	0.355008	87.54778
Roundnes	4.416585	2.948186	1.4607	13.04159	11.58089	300.3278	FractaDim	1.175382	7.80E-02	1.064771	1.389696	0.324925	79.92599
Roundnes	2.970155	1.578565	1.248586	11.35185	10.10326	406.9113	FractaDim	1.150403	6.31E-02	1.060653	1.37781	0.317157	157.6052
Roundnes	5.824467	3.15405	1.916064	15.05811	13.14205	349.468	FractaDim	1.209116	7.86E-02	1.09451	1.41123	0.31672	72.54694
Roundnes	6.404578	3.588826	1.474167	17.60517	16.131	634.0532	FractaDim	1.196737	7.47E-02	1.072673	1.393465	0.320792	118.477
Roundnes	7.401537	3.504772	1.743362	17.54906	15.8057	540.3122	FractaDim	1.199322	5.76E-02	1.081039	1.327142	0.246103	87.55048
Roundnes	4.070318	2.571249	1.415195	13.8162	12.401	333.7661	FractaDim	1.165703	6.32E-02	1.050416	1.334252	0.283835	95.58768
Roundnes	6.360464	3.596119	1.604751	21.19526	19.5905	438.872	FractaDim	1.222915	7.89E-02	1.081981	1.472938	0.390957	84.36111
Roundnes	2.878788	1.881073	1.240745	12.11699	10.87624	308.0303	FractaDim	1.139274	6.23E-02	1.046412	1.307895	0.261482	121.9023
Roundnes	2.293112	1.512334	1.178199	9.185871	8.007672	146.7592	FractaDim	1.117407	5.42E-02	1.055321	1.356984	0.301663	71.51404
Roundnes	4.074918	2.359371	1.412466	11.04531	9.632841	407.4918	FractaDim	1.176972	6.96E-02	1.080727	1.439785	0.359058	117.6972
Roundnes	5.05302	2.694699	1.899748	15.84344	13.94369	384.0295	FractaDim	1.206189	7.78E-02	1.066392	1.463483	0.397091	91.67036
Roundnes	6.038515	3.149799	1.455941	15.93141	14.47547	513.2738	FractaDim	1.226269	8.29E-02	1.050462	1.43829	0.387829	104.2329
Roundnes	3.108314	1.813116	1.359022	9.282896	7.923873	214.4737	FractaDim	1.156073	7.34E-02	1.059843	1.381138	0.321296	79.76904
Roundnes	3.628464	2.277796	1.357834	12.25357	10.89573	337.4471	FractaDim	1.163325	0.080946	1.057694	1.408768	0.351073	108.1893
Roundnes	7.158988	4.61392	1.216085	25.68569	24.4696	501.1291	FractaDim	1.207741	9.12E-02	1.064971	1.582937	0.517966	84.64184
Roundnes	3.811436	1.83882	1.470102	9.506759	8.036656	213.4404	FractaDim	1.165787	5.93E-02	1.071955	1.357497	0.285542	65.28404
Roundnes	4.157682	1.976542	1.456761	9.919761	8.462999	432.3989	FractaDim	1.196353	6.45E-02	1.072198	1.3559	0.283702	124.4208
Roundness							FractaDim						
	4.620573	2.617093	1.448454	14.05903	12.61057	361.2797		1.182981	0.07117	1.066731	1.395701	0.32897	95.03558
	1.456689	0.847913	0.182656	4.30036	4.274654	118.9993		0.027978	0.008979	0.011157	0.054393	0.053349	25.1496

FIG. 12(11)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Hetrogneity	2.12E-02	4.02E-02	0	0.192182	0.192182	2.101035	Diameter	6.090456	2.661724	2.775123	13.67258	10.89746	602.9551
Hetrogneity	1.10E-02	3.08E-02	0	0.137592	0.137592	0.591552	Diameter	6.742611	3.090764	2.585204	16.63231	14.04711	364.101
Hetrogneity	8.83E-03	3.30E-02	0	0.232258	0.232258	0.476584	Diameter	6.584189	2.981134	2.862896	13.75582	10.89292	355.5462
Hetrogneity	9.57E-03	2.23E-02	0	0.13945	0.13945	1.062746	Diameter	6.082446	1.722264	2.601632	9.702832	7.1012	675.1514
Hetrogneity	1.84E-02	3.73E-02	0	0.145875	0.145875	0.811459	Diameter	7.383221	2.270817	3.500592	11.75414	8.25355	324.8617
Hetrogneity	6.51E-03	2.00E-02	0	0.142857	0.142857	0.501057	Diameter	5.713431	1.790991	2.788497	11.13269	8.344191	439.9342
Hetrogneity	3.34E-02	5.34E-02	0	0.319202	0.319202	3.436055	Diameter	6.377511	2.098827	2.866518	10.19774	7.331226	656.8836
Hetrogneity	1.81E-03	5.52E-03	0	3.29E-02	3.29E-02	0.117925	Diameter	6.041532	1.655039	2.850644	9.785321	6.934677	392.6996
Hetrogneity	8.39E-03	2.92E-02	0	0.227743	0.227743	0.62054	Diameter	7.069963	1.988177	3.227758	11.98931	8.761551	523.1772
Hetrogneity	8.45E-03	1.90E-02	0	9.27E-02	9.27E-02	0.574464	Diameter	5.19781	1.224312	3.000623	7.747015	4.746393	353.4511
Hetrogneity	3.53E-02	6.97E-02	0	0.472477	0.472477	4.842057	Diameter	6.673252	1.977882	2.983419	13.47038	10.50696	914.2355
Hetrogneity	1.23E-02	2.09E-02	0	0.103314	0.103314	0.737784	Diameter	8.669648	3.24226	2.604371	21.71522	19.11085	520.1789
Hetrogneity	2.50E-02	5.13E-02	0	0.269129	0.269129	2.471063	Diameter	7.20775	2.308778	3.110966	12.11431	9.003343	713.5673
Hetrogneity	2.25E-02	6.05E-02	0	0.336416	0.336416	1.643547	Diameter	6.183782	2.183775	2.857154	11.62516	8.768008	451.4161
Hetrogneity	4.29E-02	8.58E-02	0	0.561125	0.561125	3.517221	Diameter	5.567077	1.474009	3.106129	8.842009	5.73588	456.5003
Hetrogneity	2.21E-02	9.25E-02	0	0.575163	0.575163	1.525423	Diameter	6.525121	2.885301	2.777953	13.29587	10.51792	450.2333
Hetrogneity	2.58E-02	3.74E-02	0	0.158974	0.158974	2.761546	Diameter	6.181172	1.635047	2.793157	11.24429	8.451135	661.3854
Hetrogneity	2.68E-02	4.85E-02	0	0.211587	0.211587	1.713598	Diameter	6.495387	1.364935	2.834492	8.913136	6.078645	415.7048
Hetrogneity	2.34E-02	4.74E-02	0	0.282609	0.282609	2.341696	Diameter	6.59109	2.446479	2.460158	13.9479	11.48774	659.1089
Hetrogneity	8.58E-04	3.32E-03	0	0.021018	0.021018	6.52E-02	Diameter	6.347938	1.833196	2.977125	10.23464	7.257515	482.4432
Hetrogneity	4.60E-04	1.83E-03	0	1.57E-02	1.57E-02	3.91E-02	Diameter	7.685116	4.012581	2.568039	22.13289	19.56486	653.2349
Hetrogneity	6.05E-03	2.10E-02	0	0.130053	0.130053	0.417727	Diameter	6.544234	1.770956	2.723541	9.518946	6.795404	451.5522
Hetrogneity	0.026338	6.44E-02	0	0.357143	0.357143	2.449397	Diameter	7.361317	2.836835	3.023995	16.22761	13.20362	684.6025
Hetrogneity	1.89E-02	4.43E-02	0	0.279743	0.279743	1.320987	Diameter	7.778751	3.079736	2.890131	17.96842	15.07829	544.5126
Hetrogneity	2.77E-03	1.00E-02	0	0.07124	0.07124	0.155099	Diameter	5.746739	1.757686	3.129967	14.07322	10.94326	321.8174
Hetrogneity	7.30E-04	2.95E-03	0	1.97E-02	1.97E-02	7.59E-02	Diameter	5.470329	1.626444	2.558928	8.226155	5.667227	568.9142
Hetrogneity							Diameter						
	0.016143	0.036633	0	0.212618	0.212618	1.398875		6.550457	2.22769	2.863039	12.68923	9.82619	524.5449
	0.011815	0.024749	0	0.155303	0.155303	1.267808		0.79347	0.687935	0.236652	3.760576	3.827543	146.8155

FIG. 12 (12)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Angle	78.173	52.05201	0.806147	177.8717	177.0655	7739.127	Silhouette	0.116128	8.41E-02	1.50E-02	0.431193	0.416178	11.49667
Angle	99.29191	47.988	0.134576	177.117	176.9824	5361.763	Silhouette	0.183742	0.125639	1.15E-02	0.479718	0.46824	9.922091
Angle	108.3766	41.1919	2.596893	167.8893	165.2924	5852.336	Silhouette	0.134606	0.102646	1.49E-03	0.463635	0.462141	7.268728
Angle	122.0897	42.88498	10.81311	176.5139	165.7008	13551.96	Silhouette	0.176793	0.103652	4.65E-03	0.545995	0.541344	19.62402
Angle	69.02059	42.42411	14.44942	178.0285	163.5791	3036.906	Silhouette	0.114467	9.22E-02	2.02E-02	0.36607	0.345845	5.036565
Angle	120.6176	54.89338	0.851029	175.5028	174.6517	9287.552	Silhouette	0.169308	0.109589	1.91E-02	0.692278	0.673194	13.03671
Angle	72.21949	40.13596	0.436989	174.3898	173.9528	7438.607	Silhouette	0.22946	0.164288	2.01E-02	0.722531	0.702439	23.63435
Angle	91.6837	36.7433	10.37004	179.6217	169.2516	5959.44	Silhouette	0.249929	0.143195	3.28E-02	0.687306	0.654526	16.2454
Angle	77.77054	62.98977	0.53363	179.9217	179.3881	5755.02	Silhouette	0.181362	0.118462	7.53E-03	0.523836	0.516309	13.42079
Angle	53.8913	62.93473	0.921345	179.9876	179.0663	3664.609	Silhouette	0.203717	0.136252	2.47E-02	0.622178	0.597454	13.85277
Angle	73.4586	46.29219	0.914228	179.7885	178.8743	10063.83	Silhouette	0.176014	0.121918	0	0.64843	0.64843	24.11396
Angle	76.25507	35.50892	3.49552	165.3014	161.8059	4575.305	Silhouette	0.1614	0.105116	2.76E-02	0.423852	0.396262	9.684006
Angle	92.24914	16.58021	36.31277	171.6985	135.3857	9132.664	Silhouette	0.123001	0.111103	0	0.506851	0.506851	12.17712
Angle	82.84105	47.78945	0.705102	178.3355	177.6304	6047.396	Silhouette	0.156152	0.113134	2.94E-02	0.480653	0.451216	11.39912
Angle	90.02003	40.17837	4.13529	179.831	175.6958	7381.643	Silhouette	0.172212	0.138972	3.70E-03	0.490208	0.486512	14.12138
Angle	74.07644	33.28793	0.336647	170.0443	169.7076	5111.274	Silhouette	0.129973	8.20E-02	1.17E-02	0.385174	0.373504	8.968165
Angle	100.4877	68.12433	0.153885	179.7684	179.6145	10752.19	Silhouette	0.206619	0.132428	1.65E-02	0.651792	0.63529	22.10821
Angle	90.75652	54.59766	9.19E-02	178.2221	178.1302	5808.417	Silhouette	0.253598	0.147947	2.43E-02	0.600882	0.576625	16.23025
Angle	86.93407	47.6854	2.172731	178.0934	175.9207	8693.406	Silhouette	0.158969	0.121053	0	0.514022	0.514022	15.8969
Angle	106.6331	60.70893	0.229727	179.8366	179.6069	8104.117	Silhouette	0.146228	9.59E-02	1.10E-02	0.46509	0.454114	11.11329
Angle	111.2215	56.00343	1.417941	179.6902	178.2723	9453.825	Silhouette	0.135611	9.02E-02	2.01E-02	0.485047	0.46499	11.5269
Angle	86.81359	62.53597	0.623966	176.7852	176.1613	5990.138	Silhouette	0.247177	0.169883	2.34E-02	0.601721	0.578299	17.05522
Angle	97.84753	63.02365	0.903819	179.7634	178.8596	9099.82	Silhouette	0.190415	0.153686	1.86E-03	0.688578	0.686716	17.70859
Angle	88.29136	47.86612	6.724116	177.0327	170.3085	6180.397	Silhouette	0.138221	0.119395	0	0.57673	0.57673	9.675501
Angle	138.9708	52.28811	9.535728	179.9987	170.463	7782.365	Silhouette	0.148406	0.107717	4.42E-04	0.518879	0.518436	8.310756
Angle	91.90865	45.81373	9.989465	179.5473	169.5578	9558.5	Silhouette	0.179046	0.109866	3.86E-02	0.509532	0.470975	18.62075
Angle							Silhouette						
	91.61152	48.55856	4.602154	176.9454	172.3433	7360.87		0.172406	0.119245	0.014059	0.537776	0.523717	13.93262
	18.73171	11.5826	7.708101	3.990514	9.27796	2385.615		0.040379	0.023628	0.011595	0.095427	0.096166	4.979248

FIG. 12 (13)

	Mean	Stdv	MinVal	MaxVal	Range	Sum
Dens*Aspect	287.8475	123.1199	120.3807	706.5579	586.1772	28498.9
Dens*Aspect	212.7888	111.8592	110.9671	727.7068	616.7397	11490.59
Dens*Aspect	383.4498	229.1751	166.7518	1453.514	1286.762	20706.29
Dens*Aspect	303.5443	128.6622	159.3107	1013.567	854.2565	33693.42
Dens*Aspect	436.4157	207.6119	198.5421	1031.275	832.7332	19202.29
Dens*Aspect	255.6093	95.00712	115.8487	543.5547	427.706	19681.92
Dens*Aspect	248.9157	103.6306	113.9757	815.4645	701.4888	25638.31
Dens*Aspect	195.916	71.14695	123.9187	548.5104	424.5916	12734.54
Dens*Aspect	216.2414	114.3117	117.1115	910.5159	793.4044	16001.86
Dens*Aspect	206.5205	80.45625	100.2474	554.6296	454.3822	14043.39
Dens*Aspect	257.8809	125.4843	120.8172	843.4061	722.5889	35329.68
Dens*Aspect	281.6441	121.3101	160.1935	735.0098	574.8163	16898.65
Dens*Aspect	360.1682	174.916	150.2045	1285.565	1135.36	35656.65
Dens*Aspect	270.3897	117.7161	125.4981	645.481	519.9829	19738.45
Dens*Aspect	371.0524	240.5052	137.4978	1463.019	1325.521	30426.3
Dens*Aspect	310.7911	133.3931	156.6497	849.3142	692.6646	21444.59
Dens*Aspect	250.1987	93.07534	119.0045	637.6892	518.6848	26771.26
Dens*Aspect	260.6587	118.4573	139.4087	748.6794	609.2706	16682.15
Dens*Aspect	326.1862	218.0354	149.1248	1712.415	1563.29	32618.62
Dens*Aspect	312.5259	173.8868	145.516	1158.036	1012.52	23751.97
Dens*Aspect	271.2649	111.2823	139.4417	709.6108	570.1691	23057.52
Dens*Aspect	227.7484	110.9677	120.8833	616.0188	495.1355	15714.64
Dens*Aspect	251.904	114.1853	124.2775	780.2603	655.9827	23427.07
Dens*Aspect	330.4725	143.6027	153.4873	778.5095	625.0222	23133.08
Dens*Aspect	326.5715	171.3329	135.7257	991.2877	855.5619	16288
Dens*Aspect	272.2647	88.98221	154.0626	516.2382	362.1757	28315.53
Dens*Aspect						
	285.7297	135.4659	136.8787	875.9937	739.1149	22805.53
	58.86201	46.36536	21.95722	312.9915	303.5174	6976.763

FIG. 12 (14)

	Mean	Stdv	MinVal	MaxVal	Range	Sum
HetrDnsity	0.826619	2.448306	0	14.2013	14.2013	81.83529
HetrDnsity	0.623553	2.319579	0	12.6346	12.6346	33.67186
HetrDnsity	0.170371	0.606276	0	3.914299	3.914299	9.200029
HetrDnsity	0.356701	1.194385	0	8.742012	8.742012	39.59383
HetrDnsity	0.813476	2.634565	0	13.64102	13.64102	35.79292
HetrDnsity	0.45986	1.879195	0	15.28715	15.28715	35.40923
HetrDnsity	2.368569	4.939811	0	27.43572	27.43572	243.9626
HetrDnsity	0.130563	0.52644	0	4.074594	4.074594	8.486588
HetrDnsity	0.456162	2.46324	0	21.08456	21.08456	33.756
HetrDnsity	0.685213	1.987287	0	10.64021	10.64021	46.59449
HetrDnsity	0.805417	2.829138	0	18.35835	18.35835	110.3422
HetrDnsity	1.042762	2.736519	0	16.08534	16.08534	62.56574
HetrDnsity	1.589853	4.733862	0	31.18408	31.18408	157.3955
HetrDnsity	1.143209	5.28673	0	32.34936	32.34936	83.45429
HetrDnsity	2.096847	5.582148	0	31.45997	31.45997	171.9415
HetrDnsity	0.698888	3.447029	0	25.86369	25.86369	48.22324
HetrDnsity	1.612419	3.498563	0	16.65494	16.65494	172.5289
HetrDnsity	0.581551	1.799059	0	11.23025	11.23025	37.21925
HetrDnsity	0.437169	1.616016	0	11.03895	11.03895	43.71687
HetrDnsity	0.105439	0.467602	0	3.047969	3.047969	8.013349
HetrDnsity	9.57E-03	6.27E-02	0	0.549564	0.549564	0.81324
HetrDnsity	0.625458	2.198175	0	12.96093	12.96093	43.15658
HetrDnsity	1.428463	4.923763	0	32.52551	32.52551	132.847
HetrDnsity	1.049532	4.449861	0	31.41874	31.41874	73.46726
HetrDnsity	0.276836	1.190557	0	8.503137	8.503137	15.50281
HetrDnsity	2.87E-02	0.210497	0	2.065777	2.065777	2.98943
HetrDnsity						
	0.785509	2.539665	0	16.03277	16.03277	66.63386
	0.618729	1.651453	0	10.2212	10.2212	62.44319

FIG. 12 (15)

FIG. 13 (1)

Statistics					Mean	Stdv	MinVal	MaxVal	Range	Sum
numobjs =	127	CalibrationX	0.266663	Area	28.09777	22.66611	5.429525	149.2437	143.8142	3568.417
numobjs =	180	CalibrationX	0.266663	Area	36.37422	38.61505	5.042579	284.239	279.1964	6547.359
numobjs =	109	CalibrationX	0.266663	Area	50.92923	40.11071	5.392998	260.1159	254.7229	5551.286
numobjs =	145	CalibrationX	0.266663	Area	20.80301	23.61073	5.046745	229.0657	224.019	3016.436
numobjs =	70	CalibrationX	0.266663	Area	25.46721	21.07742	5.053013	139.0689	134.0159	1782.705
numobjs =	122	CalibrationX	0.266663	Area	40.05106	36.14618	5.035281	262.0495	257.0142	4886.229
numobjs =	76	CalibrationX	0.266663	Area	21.56861	22.61168	5.499386	118.4376	112.9382	1639.215
numobjs =	65	CalibrationX	0.266663	Area	15.12656	14.79033	5.066565	87.24967	82.18311	983.2266
numobjs =	110	CalibrationX	0.266663	Area	30.66967	29.67477	5.221961	210.7059	205.484	3373.664
numobjs =	123	CalibrationX	0.266663	Area	37.9697	46.18851	5.007118	352.0275	347.0204	4670.273
numobjs =	120	CalibrationX	0.266663	Area	42.6013	30.79916	5.106199	158.2547	153.1485	5112.156
numobjs =	79	CalibrationX	0.266663	Area	45.96438	52.70532	5.555704	386.4193	380.8636	3631.186
numobjs =	150	CalibrationX	0.266663	Area	52.68296	54.5452	5.732999	385.2742	379.5412	7902.444
numobjs =	50	CalibrationX	0.266663	Area	27.89839	26.28796	5.381527	148.0986	142.7171	1394.919
numobjs =	120	CalibrationX	0.266663	Area	21.98221	22.83002	5.211534	118.9445	113.733	2637.865
numobjs =	60	CalibrationX	0.266663	Area	47.33761	44.08938	5.05617	144.0812	139.025	2840.257
numobjs =	63	CalibrationX	0.266663	Area	39.43067	24.46533	6.237795	134.3006	128.0628	2484.132
numobjs =	54	CalibrationX	0.266663	Area	18.07274	14.74338	5.382579	102.1241	96.74152	975.928
numobjs =	93	CalibrationX	0.266663	Area	26.4707	22.44963	5.127054	107.3428	102.2158	2461.775
numobjs =	37	CalibrationX	0.266663	Area	34.40134	15.00777	7.670808	67.62592	59.95511	1272.849
numobjs =	67	CalibrationX	0.266663	Area	19.90621	16.79318	5.27099	94.91528	89.64429	1333.716
numobjs =	74	CalibrationX	0.266663	Area	36.29034	27.97032	5.92907	118.0839	112.1549	2685.485
numobjs =	134	CalibrationX	0.266663	Area	32.54256	34.30759	5.045712	190.4688	185.4231	4360.704
numobjs =	94	CalibrationX	0.266663	Area	47.27167	73.13563	5.284525	634.2577	628.9731	4443.537
numobjs =	43	CalibrationX	0.266663	Area	32.19921	29.93325	5.376313	129.0067	123.6304	1384.566
numobjs =	184	CalibrationX	0.266663	Area	32.08672	23.67151	5.04675	141.0964	136.0496	5903.957
numobjs =	26	CalibrationX	0.266663	Area	38.1643	22.20518	7.471558	92.57387	85.10231	992.2717
		CalibrationX		Area						
Average	95.37037		0.266663		33.42075	30.79375	5.469721	194.2619	188.7922	3253.206
STDev	42.31398		6.53E-09		10.39847	13.8753	0.674926	126.0475	126.2115	1888.425

FIG. 13 (2)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Aspect	1.838853	0.696188	1.060408	6.797375	5.736968	233.5343	Density	102.8072	6.317374	85.6677	116.316	30.64835	13056.52
Aspect	2.135876	1.105732	1.05277	8.193454	7.140683	384.4577	Density	137.0506	11.17948	107.0591	157.8442	50.7851	24669.11
Aspect	1.81956	0.657038	1.034195	4.326134	3.291939	198.332	Density	152.302	8.877128	123.3061	168.0245	44.71838	16600.92
Aspect	1.801132	0.639689	1.012375	3.894525	2.88215	261.1641	Density	139.9907	10.63057	107.6587	159.0126	51.35387	20298.65
Aspect	1.801599	0.634077	1.072531	4.207522	3.134991	126.1119	Density	141.7564	5.197337	125.2201	150.7091	25.48897	9922.945
Aspect	2.208959	1.658308	1.015829	17.2698	16.25397	269.493	Density	116.3868	9.70554	82.57576	135.3981	52.82239	14199.19
Aspect	1.919855	0.715157	1.01246	3.853746	2.841287	145.909	Density	138.7304	10.39909	100.8699	161.3835	60.5136	10543.51
Aspect	2.118129	0.988228	1.08099	5.904213	4.823223	137.6784	Density	117.6711	9.566601	82.83022	129.5545	46.72427	7648.621
Aspect	1.917265	0.963009	1.011182	5.826657	4.815475	210.8992	Density	118.9513	8.441553	95.24191	135.3117	40.06982	13084.64
Aspect	1.773661	0.4985	1.104244	3.749926	2.645682	218.1602	Density	134.3555	8.137854	99.16518	144.6263	45.46108	16525.72
Aspect	1.923053	0.692459	1.051038	4.220122	3.169085	230.7663	Density	119.2162	8.315302	86.27357	134.2023	47.92871	14305.94
Aspect	2.193675	0.929792	1.08602	5.132807	4.046788	173.3004	Density	98.1213	8.429456	79.19585	113.4298	34.23392	7751.583
Aspect	1.737749	0.511398	1.064109	3.699696	2.635587	260.6624	Density	99.88653	9.300559	65.28519	119.7504	54.46519	14982.98
Aspect	2.040854	0.833342	1.053585	4.556038	3.502453	102.0427	Density	158.0279	10.74947	127.9318	177.6879	49.75605	7901.397
Aspect	2.082591	0.872383	1.037895	6.086729	5.048834	249.9109	Density	137.5999	6.786001	109.7578	151.2943	41.53651	16511.99
Aspect	2.206545	1.543444	1.122926	9.943015	8.820089	132.3927	Density	174.3058	4.429187	160.014	183.6059	23.59184	10458.35
Aspect	1.979609	1.232491	1.054284	9.05692	8.002636	124.7153	Density	144.3324	6.577986	116.5039	157.119	40.61514	9092.943
Aspect	1.749788	0.75274	1.030848	4.270715	3.239868	94.48656	Density	154.4558	9.022954	120.9873	170.0111	49.02383	8340.616
Aspect	1.923535	0.664941	1.067707	4.04862	2.980913	178.8888	Density	125.3654	10.49078	100.7751	141.5362	40.76111	11658.99
Aspect	1.959104	0.544292	1.068653	3.298269	2.229617	72.48686	Density	127.6285	8.080369	108.06	141.9284	33.86842	4722.255
Aspect	1.880404	0.924329	1.029756	5.430924	4.401168	125.9871	Density	125.5596	8.354487	97.81667	139.5666	41.74989	8412.493
Aspect	2.042209	0.816632	1.105716	5.402853	4.297137	151.1235	Density	140.6609	12.51821	112.4688	166.1629	53.69411	10408.91
Aspect	2.020066	0.797958	1.027925	4.619083	3.591158	270.6868	Density	118.7018	8.846797	83.25301	136.0218	52.76878	15906.04
Aspect	1.882331	0.702826	1.05021	4.642485	3.592276	176.9391	Density	148.1676	11.29112	116.8155	167.1239	48.3084	13927.76
Aspect	2.362548	1.05811	1.095227	5.884656	4.789429	101.5896	Density	124.9137	7.69893	105.0472	136.1443	31.0971	5371.29
Aspect	2.269469	1.048218	1.02213	7.256374	6.234244	417.5823	Density	116.9546	9.597967	94.34126	135.9893	41.64802	21519.64
Aspect	1.574384	0.385506	1.110538	2.51411	1.403572	40.93398	Density	147.3804	10.22367	119.2141	161.0962	41.88208	3831.89
Aspect							Density						
	1.968993	0.846918	1.056872	5.706917	4.650045	188.5274		131.8993	8.857992	104.2717	147.8093	43.53759	12283.51
	0.186206	0.296399	0.032529	2.900661	2.90554	88.60308		18.34212	1.887783	19.5391	18.43521	9.17391	5128.097

FIG. 13 (3)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
DensityStd	7.686229	2.599073	3.047456	16.75732	13.70986	976.1511	Perimeter	29.27587	13.91669	12.92254	96.50047	83.57793	3718.035
DensityStd	14.90346	4.984292	4.493471	29.64539	25.15192	2682.622	Perimeter	38.07195	26.62718	9.573253	184.0172	174.444	6852.951
DensityStd	10.62743	4.618017	3.794665	22.02589	18.23122	1158.39	Perimeter	40.71838	18.55672	12.16132	107.6208	95.45945	4438.303
DensityStd	13.52978	5.09467	3.28555	27.9589	24.67335	1961.818	Perimeter	27.84708	19.67136	9.360804	161.3115	151.9507	4037.627
DensityStd	11.23158	3.995914	5.220976	22.60783	17.38685	786.2106	Perimeter	35.83755	18.98377	10.24487	140.4133	130.1685	2508.629
DensityStd	11.94744	4.990937	3.923223	29.68353	25.76031	1457.588	Perimeter	35.10153	24.70484	10.64322	189.9407	179.2975	4282.387
DensityStd	12.72608	5.198994	4.193097	26.00397	21.81087	967.1819	Perimeter	31.2129	18.06806	9.976007	118.3314	108.3553	2372.18
DensityStd	9.118946	3.871329	4.264901	23.97519	19.71029	592.7314	Perimeter	26.5923	14.95648	9.875302	65.32314	55.44783	1728.5
DensityStd	9.778307	3.977969	4.525709	25.4163	20.89059	1075.614	Perimeter	37.57653	21.32212	11.65786	142.8477	131.1899	4133.418
DensityStd	8.089587	3.341179	3.231703	19.63845	16.40674	995.0192	Perimeter	40.47015	25.3744	11.66558	162.4278	150.7623	4977.829
DensityStd	10.90743	3.453481	3.378244	20.01102	16.63277	1308.892	Perimeter	38.72792	18.87804	9.733689	104.3732	94.63951	4647.351
DensityStd	10.79389	4.66692	3.678198	23.17052	19.59232	852.7175	Perimeter	40.56074	29.18517	10.10658	219.8109	209.7043	3204.299
DensityStd	8.923659	2.983467	3.138054	19.22722	16.08916	1338.549	Perimeter	39.49148	26.51222	11.97102	169.1109	157.1398	5923.722
DensityStd	14.58457	5.877738	4.979157	28.01052	23.03136	729.2284	Perimeter	34.72968	19.21295	11.37457	118.1489	106.7743	1736.484
DensityStd	10.02336	3.496409	4.143647	23.3875	19.24385	1202.803	Perimeter	32.7947	23.15607	10.10658	166.6259	156.5193	3935.364
DensityStd	8.941115	4.844598	2.971121	23.2651	20.29398	536.4669	Perimeter	48.62846	23.62591	10.27474	113.5239	103.2492	2917.708
DensityStd	9.682273	4.092041	3.012164	23.9271	20.91494	609.9832	Perimeter	42.12481	17.70988	13.24674	105.025	91.77827	2653.863
DensityStd	10.91544	4.291173	4.709516	29.88837	25.17886	589.4336	Perimeter	25.01091	14.25553	10.34889	92.9056	82.55671	1350.589
DensityStd	12.75092	5.180383	3.187871	26.1527	22.96483	1185.835	Perimeter	34.32824	17.42477	9.901848	90.51015	80.60831	3192.526
DensityStd	11.87671	3.812779	4.691241	20.52886	15.83762	439.4383	Perimeter	32.02869	10.81826	16.0694	80.44114	64.37173	1185.062
DensityStd	10.53797	3.341358	4.909455	22.21544	17.30598	706.0441	Perimeter	25.47019	12.45475	9.755836	61.8954	52.13956	1706.503
DensityStd	14.14545	4.952435	5.006644	23.60706	18.60042	1046.764	Perimeter	35.87693	17.40135	11.66558	105.2715	93.60593	2654.893
DensityStd	11.06073	4.628963	3.995077	22.24453	18.24945	1482.138	Perimeter	39.28143	25.58774	10.94195	132.1857	121.2438	5263.711
DensityStd	12.8993	6.057114	3.416916	24.76971	21.3528	1212.534	Perimeter	44.69363	53.09306	9.703824	490.6123	480.9085	4201.202
DensityStd	11.10879	4.944489	3.200302	22.38772	19.18742	477.6781	Perimeter	37.38131	23.88319	12.70569	110.4203	97.71458	1607.396
DensityStd	11.9651	3.767465	3.965489	21.23643	17.27094	2201.579	Perimeter	31.30185	16.27719	9.651811	111.222	101.5702	5759.541
DensityStd	12.2017	4.75901	5.400885	22.99033	17.58944	317.2441	Perimeter	37.68259	14.06682	17.85968	72.57955	54.71987	979.7473
DensityStd							Perimeter						
	11.22064	4.326748	3.987583	23.73085	19.74326	1070.024		35.65992	20.96017	11.24071	137.5332	126.2925	3406.297
	1.89089	0.800654	0.757418	3.323787	3.191482	549.7139		5.826096	8.033168	2.007026	80.99766	81.61769	1582.25

FIG. 13 (4)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Roundness	2.931916	1.843221	1.198231	18.03301	16.83478	372.3534	FractaDim	1.14191	5.76E-02	1.055788	1.325549	0.269761	145.0225
Roundness	3.980881	2.638524	1.263631	13.39801	12.13438	716.5587	FractaDim	1.156173	6.77E-02	1.058285	1.354606	0.296321	208.1111
Roundness	3.612751	2.175225	1.319226	13.74083	12.42161	393.7899	FractaDim	1.158323	6.99E-02	1.054586	1.392185	0.337599	126.2572
Roundness	3.828046	3.05073	1.211514	19.18221	17.9707	555.0667	FractaDim	1.150587	7.14E-02	1.04981	1.433536	0.383726	166.8351
Roundness	5.267034	3.755794	1.351729	23.48939	22.13766	368.6924	FractaDim	1.196522	6.96E-02	1.075695	1.405201	0.329507	83.75655
Roundness	3.087147	2.407778	1.274378	20.17197	18.89759	376.6319	FractaDim	1.132634	5.49E-02	1.052145	1.304552	0.252407	138.1814
Roundness	4.798909	3.272086	1.250852	17.83776	16.58691	364.7171	FractaDim	1.167278	6.78E-02	1.058198	1.387901	0.329702	88.71316
Roundness	4.681779	3.3857	1.221218	14.62639	13.40517	304.3156	FractaDim	1.161713	7.99E-02	1.065621	1.504199	0.438578	75.51134
Roundness	4.675683	2.625516	1.464972	14.23632	12.77135	514.3252	FractaDim	1.182509	6.64E-02	1.059468	1.361331	0.301863	130.076
Roundness	4.70786	2.799032	1.364314	14.94104	13.57673	579.0668	FractaDim	1.191892	6.83E-02	1.058023	1.368468	0.310446	146.6027
Roundness	3.569426	2.487813	1.184229	14.27289	13.08866	428.3311	FractaDim	1.145693	6.64E-02	1.055282	1.305361	0.250079	137.4832
Roundness	3.629186	2.139348	1.26974	11.61907	10.34933	286.7057	FractaDim	1.153339	6.81E-02	1.05525	1.312796	0.257547	91.11374
Roundness	2.865321	1.505897	1.320953	10.07623	8.755277	429.7982	FractaDim	1.140621	5.95E-02	1.058215	1.354634	0.296419	171.0932
Roundness	4.256698	2.265697	1.379211	10.33675	8.95754	212.8349	FractaDim	1.169239	6.74E-02	1.058695	1.386386	0.327691	58.46193
Roundness	4.804359	3.34942	1.436431	19.2307	17.79427	576.5231	FractaDim	1.182566	6.70E-02	1.060222	1.358004	0.297782	141.908
Roundness	6.408075	4.402483	1.587228	23.04116	21.45393	384.4845	FractaDim	1.204281	7.82E-02	1.079544	1.401603	0.322059	72.25689
Roundness	4.675605	3.375285	1.554832	15.03093	13.4761	294.5631	FractaDim	1.183128	7.27E-02	1.070938	1.380164	0.309226	74.53706
Roundness	3.231937	2.19996	1.315543	10.23243	8.91689	174.5246	FractaDim	1.131833	5.31E-02	1.049797	1.252071	0.202274	61.11898
Roundness	4.628146	3.204012	1.264699	17.50225	16.23755	430.4176	FractaDim	1.164942	7.17E-02	1.060143	1.411795	0.351652	108.3396
Roundness	2.722627	1.473316	1.448592	7.61436	6.165768	100.7372	FractaDim	1.131664	5.47E-02	1.063079	1.348197	0.285119	41.87157
Roundness	2.971292	1.300302	1.210856	6.211755	5.000899	199.0765	FractaDim	1.153693	5.86E-02	1.072499	1.304008	0.231509	77.29745
Roundness	3.545818	2.356171	1.341771	15.40493	14.06316	262.3905	FractaDim	1.150472	6.43E-02	1.063756	1.421283	0.357528	85.1349
Roundness	4.974887	3.110518	1.373047	17.33814	15.96509	666.6349	FractaDim	1.183632	6.99E-02	1.052489	1.396095	0.343607	158.6068
Roundness	4.152812	3.606942	1.310043	30.19961	28.88957	390.3643	FractaDim	1.164196	6.59E-02	1.059329	1.376	0.316671	109.4345
Roundness	4.109965	2.603246	1.409183	12.38039	10.97121	176.7285	FractaDim	1.145817	5.93E-02	1.054824	1.306782	0.251957	49.27013
Roundness	2.792864	1.404511	1.330645	8.020281	6.689636	513.887	FractaDim	1.119151	5.20E-02	1.044528	1.317483	0.272955	205.9238
Roundness	3.532407	1.858784	1.42565	8.59674	7.17109	91.84258	FractaDim	1.168816	7.19E-02	1.079013	1.372958	0.293945	30.38401
Roundness							FractaDim						
	4.016423	2.611012	1.336397	15.06539	13.72899	376.4949		1.16046	0.065697	1.060193	1.364561	0.304368	110.4927
	0.897297	0.789043	0.104116	5.452046	5.449329	162.7735		0.021552	0.007265	0.008814	0.051765	0.049427	48.3266

FIG. 13 (5)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Hetrogneity	2.96E-03	1.14E-02	0	0.10559	0.10559	0.375782	Diameter	5.925326	2.242606	2.796667	17.1124	14.31573	752.5165
Hetrogneity	1.06E-01	0.106421	0	0.570839	0.570839	19.13736	Diameter	6.809231	3.087215	2.691722	20.29481	17.60309	1225.662
Hetrogneity	4.16E-02	6.28E-02	0	0.260736	0.260736	4.532961	Diameter	7.892395	3.229212	2.54082	19.55496	17.01414	860.2711
Hetrogneity	8.51E-02	9.91E-02	0	0.547619	0.547619	12.33565	Diameter	5.237821	2.247832	2.623915	17.35971	14.7358	759.484
Hetrogneity	4.36E-02	5.90E-02	0	0.254072	0.254072	3.049738	Diameter	5.828807	2.039509	2.779506	13.52062	10.74112	408.0165
Hetrogneity	5.73E-02	8.52E-02	0	0.561688	0.561688	6.986723	Diameter	6.950698	2.876417	2.783458	17.48286	14.6994	847.9852
Hetrogneity	7.30E-02	9.56E-02	0	0.370236	0.370236	5.545955	Diameter	5.556281	2.353515	2.788722	13.22259	10.43387	422.2774
Hetrogneity	2.11E-02	4.65E-02	0	0.275701	0.275701	1.373051	Diameter	4.726707	1.728188	2.630774	10.85824	8.22747	307.2359
Hetrogneity	2.66E-02	5.28E-02	0	0.337325	0.337325	2.921139	Diameter	6.250628	2.665731	2.791419	17.0049	14.21348	687.5692
Hetrogneity	1.34E-02	3.37E-02	0	0.207116	0.207116	1.651515	Diameter	6.694345	3.319014	2.84987	22.14327	19.2934	823.4045
Hetrogneity	2.95E-02	4.20E-02	0	0.208145	0.208145	3.536009	Diameter	7.365476	2.778505	2.603747	14.12629	11.52254	883.8571
Hetrogneity	3.63E-02	5.47E-02	0	0.261905	0.261905	2.870191	Diameter	7.421073	3.752437	2.942031	26.72701	23.78498	586.2648
Hetrogneity	9.93E-03	2.57E-02	0	0.164278	0.164278	1.489939	Diameter	7.678855	3.531129	2.818784	22.32577	19.50698	1151.828
Hetrogneity	1.13E-01	1.22E-01	0	0.447633	0.447633	5.649436	Diameter	6.021136	2.180328	3.015385	13.79911	10.78373	301.0568
Hetrogneity	2.39E-02	4.05E-02	0	0.2578	0.2578	2.867194	Diameter	5.366866	2.381534	2.543437	15.09887	12.55543	644.0239
Hetrogneity	3.76E-02	5.84E-02	0	0.314875	0.314875	2.256266	Diameter	7.621798	3.503239	2.773562	13.68615	10.91259	457.3079
Hetrogneity	3.25E-02	5.37E-02	0	0.305164	0.305164	2.046677	Diameter	7.264153	2.322684	3.167155	13.33055	10.16339	457.6417
Hetrogneity	3.09E-02	8.76E-02	0	0.577778	0.577778	1.6687	Diameter	5.089502	1.798669	2.846672	13.17513	10.32846	274.8331
Hetrogneity	7.67E-02	8.36E-02	0	0.362538	0.362538	7.129529	Diameter	6.027168	2.134754	2.650445	12.15676	9.506311	560.5266
Hetrogneity	4.44E-02	5.81E-02	0	0.270073	0.270073	1.642809	Diameter	6.869994	1.687689	3.490398	10.76954	7.279142	254.1898
Hetrogneity	2.40E-02	4.26E-02	0	0.245833	0.245833	1.610745	Diameter	5.043137	2.000882	2.655335	11.43538	8.780041	337.8901
Hetrogneity	9.41E-02	9.87E-02	0	0.372	0.372	6.965109	Diameter	6.923467	2.695068	2.949847	14.43852	11.48867	512.3365
Hetrogneity	4.35E-02	6.76E-02	0	0.281669	0.281669	5.828213	Diameter	6.46479	3.118373	2.669593	16.61778	13.94818	866.2819
Hetrogneity	7.82E-02	9.25E-02	0	0.411067	0.411067	7.354796	Diameter	7.386466	5.06495	2.671703	43.49023	40.81852	694.3278
Hetrogneity	5.23E-02	7.47E-02	0	0.31016	0.31016	2.250852	Diameter	6.503428	2.786607	2.897695	13.4581	10.56041	279.6474
Hetrogneity	4.52E-02	5.69E-02	0	0.253564	0.253564	8.32327	Diameter	6.555007	2.449054	2.880734	16.27049	13.38976	1206.121
Hetrogneity	6.96E-02	8.74E-02	0	0.328	0.328	1.808846	Diameter	6.913515	1.98231	3.799595	10.83344	7.033842	179.7514
Hetrogneity							Diameter						
	0.048614	0.066638	0	0.328274	0.328274	4.563276		6.458817	2.665091	2.839	16.67754	13.83854	620.0855
	0.029273	0.026811	0	0.123489	0.123489	4.039969		0.891333	0.751655	0.277414	6.628776	6.703835	298.5297

FIG. 13 (6)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Angle	88.12034	56.93453	0.175789	179.6525	179.4767	11191.28	Silhouette	1.78613	5.226634	0	28.29236	28.29236	226.8385
Angle	103.621	64.50075	0.804693	179.9099	179.1052	18651.78	Silhouette	1.062641	5.7256	0	63.1866	63.1866	191.2754
Angle	89.51501	50.38796	2.34E-01	178.254	178.0204	9757.136	Silhouette	8.504245	13.63238	0	68.73991	68.73991	926.9626
Angle	72.48033	52.92224	0.307441	179.319	179.0116	10509.65	Silhouette	4.210319	8.583655	0	42.83607	42.83607	610.4962
Angle	97.24018	55.02834	1.859806	170.7463	168.8865	6806.813	Silhouette	5.464523	10.67773	0	58.95597	58.95597	382.5166
Angle	102.4805	31.2509	10.069	179.7131	169.6441	12502.62	Silhouette	3.211102	7.441329	0	36.8357	36.8357	391.7545
Angle	82.44364	55.91542	0.691332	178.1155	177.4241	6265.717	Silhouette	2.137607	4.542127	0	17.41666	17.41666	162.4582
Angle	84.50179	55.63261	1.886109	174.5687	172.6826	5492.617	Silhouette	1.924004	5.651178	0	38.16406	38.16406	125.0603
Angle	98.6566	56.4739	3.44E+00	179.6825	176.2437	10862.23	Silhouette	0.793478	3.056309	0	19.4269	19.4269	87.28261
Angle	109.1654	55.41468	6.98E-02	179.6382	179.5684	13427.34	Silhouette	1.813708	5.200669	0	41.57305	41.57305	223.0861
Angle	101.0423	59.42883	0.249091	178.1733	177.9242	12125.08	Silhouette	0.935441	3.121724	0	20.53866	20.53866	112.253
Angle	94.9653	50.63982	2.848913	172.7055	169.8566	7502.259	Silhouette	1.656389	3.300277	0	21.17708	21.17708	130.8548
Angle	87.83844	46.18922	2.489795	179.7348	177.245	13175.77	Silhouette	2.234005	5.11226	0	32.27224	32.27224	335.1007
Angle	97.37411	55.15258	9.400087	178.6014	169.2013	4868.705	Silhouette	0.939664	2.252936	0	10.72491	10.72491	46.98321
Angle	85.65483	57.90802	1.131995	178.5387	177.4067	10278.58	Silhouette	3.080176	10.36498	0	79.5389	79.5389	369.6211
Angle	119.5601	46.39068	3.189945	175.4131	172.2231	7173.605	Silhouette	1.496559	4.425359	0	22.23254	22.23254	89.79356
Angle	100.8722	47.12931	6.48E-02	178.8326	178.7677	6354.949	Silhouette	0.556571	1.848896	0	9.975317	9.975317	35.06397
Angle	63.56736	48.81826	1.414218	177.0903	175.6761	3432.637	Silhouette	1.842089	3.329145	0	18.55731	18.55731	99.47282
Angle	71.80991	50.44379	3.279003	178.2195	174.9405	6678.322	Silhouette	1.876855	5.069074	0	30.4514	30.4514	174.5475
Angle	73.09304	57.318	0.638453	175.1942	174.5558	2704.443	Silhouette	4.699542	8.788509	0	37.62827	37.62827	173.883
Angle	79.92147	53.63192	0.511425	178.9584	178.447	5354.739	Silhouette	3.582881	6.122617	0	24.47392	24.47392	240.053
Angle	94.69912	54.33158	0.358483	175.5191	175.1606	7007.734	Silhouette	1.67815	3.667707	0	17.42716	17.42716	124.1831
Angle	89.22104	55.67226	2.677025	179.5073	176.8303	11955.62	Silhouette	5.709905	10.39572	0	43.37619	43.37619	765.1272
Angle	89.78307	63.22136	1.011558	179.603	178.5914	8439.608	Silhouette	2.760452	6.880828	0	34.11291	34.11291	259.4825
Angle	86.85106	58.03303	0.248032	172.0489	171.8008	3734.596	Silhouette	6.457681	8.890786	0	28.88236	28.88236	277.6803
Angle	85.36414	64.5022	0.925846	179.9999	179.074	15707	Silhouette	3.084218	8.643573	0	52.8525	52.8525	567.4962
Angle	95.27251	60.07758	7.484964	176.7985	169.3135	2477.085	Silhouette	2.629839	4.272173	0	13.33787	13.33787	68.37581
Angle							Silhouette						
	90.55981	54.19814	2.128149	177.5755	175.4473	8682.515		2.819562	6.156451	0	33.81433	33.81433	266.5816
	12.31164	6.767061	2.71843	2.607682	3.646824	4085.82		1.927735	2.969563	0	18.1524	18.1524	222.8146

FIG. 13 (7)

	Mean	Stdv	MinVal	MaxVal	Range	Sum		Mean	Stdv	MinVal	MaxVal	Range	Sum
Dens*Aspect	202.7556	90.61273	108.3717	711.8306	603.4589	25749.96	HetrDnsity	0.202382	0.900445	0	9.045658	9.045658	25.70246
Dens*Aspect	326.598	160.4862	150.3602	1070.311	919.9507	58787.64	HetrDnsity	8.233995	12.73422	0	68.73991	68.73991	1482.119
Dens*Aspect	310.2107	102.3886	166.3789	667.9883	501.6094	33812.97	HetrDnsity	2.124455	5.981653	0	35.28175	35.28175	231.5656
Dens*Aspect	331.3674	188.888	116.91	1386.641	1269.73	48048.28	HetrDnsity	4.814343	9.446011	0	58.95597	58.95597	698.0798
Dens*Aspect	273.5271	102.7166	157.908	620.9781	463.0701	19146.9	HetrDnsity	2.148422	6.393219	0	36.8357	36.8357	150.3896
Dens*Aspect	319.4327	187.6776	126.364	1201.623	1075.259	38970.79	HetrDnsity	2.442578	5.036288	0	21.85954	21.85954	297.9945
Dens*Aspect	301.0708	146.0955	148.4092	806.5335	658.1243	22881.38	HetrDnsity	1.566632	5.24901	0	38.16406	38.16406	119.064
Dens*Aspect	261.7183	97.56937	135.4679	640.3077	504.8398	17011.69	HetrDnsity	0.147696	0.870849	0	6.823489	6.823489	9.600255
Dens*Aspect	282.3397	143.4712	104.8893	861.2261	756.3368	31057.36	HetrDnsity	1.41238	4.8766	0	41.57305	41.57305	155.3618
Dens*Aspect	273.293	101.2792	131.9132	650.2672	518.3539	33615.04	HetrDnsity	0.817372	2.928665	0	20.53866	20.53866	100.5368
Dens*Aspect	255.7759	103.3237	117.1769	723.6149	606.438	30693.11	HetrDnsity	1.478364	2.880095	0	21.17708	21.17708	177.4037
Dens*Aspect	226.2997	102.3177	90.37898	625.0367	534.6578	17877.68	HetrDnsity	1.970783	4.836273	0	29.7078	29.7078	155.6919
Dens*Aspect	188.6789	93.35308	94.61815	1078.958	984.3398	28301.83	HetrDnsity	0.66662	1.863475	0	11.35727	11.35727	99.99294
Dens*Aspect	325.3814	137.8059	172.8276	826.7621	653.9346	16269.07	HetrDnsity	6.51387	15.27658	0	79.5389	79.5389	325.6935
Dens*Aspect	280.7408	101.3946	141.2097	669.6616	528.4518	33688.9	HetrDnsity	1.474785	4.286621	0	28.29553	28.29553	176.9743
Dens*Aspect	374.1194	214.7839	197.3796	1707.861	1510.482	22447.16	HetrDnsity	0.517963	1.847517	0	9.975317	9.975317	31.07778
Dens*Aspect	272.1586	110.7504	150.5681	751.1295	600.5615	17145.99	HetrDnsity	1.684152	3.297491	0	18.55731	18.55731	106.1016
Dens*Aspect	395.4461	228.1501	159.1741	1282.342	1123.168	21354.09	HetrDnsity	1.235621	4.54924	0	30.4514	30.4514	66.72354
Dens*Aspect	294.4322	162.2373	128.1372	1412.131	1283.994	27382.2	HetrDnsity	3.785032	7.564347	0	37.62827	37.62827	352.008
Dens*Aspect	258.0676	85.91901	151.5117	579.7123	428.2007	9548.502	HetrDnsity	3.790383	5.443861	0	19.31061	19.31061	140.2442
Dens*Aspect	242.848	108.3986	127.1114	685.9357	558.8243	16270.82	HetrDnsity	1.353521	3.05497	0	14.65721	14.65721	90.68587
Dens*Aspect	283.5124	90.7669	170.3085	621.9781	451.6696	20979.92	HetrDnsity	8.990383	12.53029	0	43.37619	43.37619	665.2883
Dens*Aspect	259.6663	113.5751	127.9195	624.4514	496.5318	34795.29	HetrDnsity	1.931161	5.340489	0	28.71191	28.71191	258.7755
Dens*Aspect	294.2213	131.7949	143.521	865.9117	722.3907	27656.8	HetrDnsity	6.517602	11.09675	0	52.8525	52.8525	612.6546
Dens*Aspect	317.9398	157.94	136.9808	724.5507	587.5699	13671.41	HetrDnsity	0.951546	4.861365	0	31.96834	31.96834	40.91646
Dens*Aspect	288.8469	134.7751	113.4228	829.8814	716.4586	53147.83	HetrDnsity	3.428863	5.084672	0	22.58584	22.58584	630.9107
Dens*Aspect	375.3242	235.5329	176.9237	1161.048	984.124	9758.431	HetrDnsity	2.391823	4.857067	0	21.61456	21.61456	62.1874
Dens*Aspect							HetrDnsity						
	289.4731	134.5927	138.746	881.0619	742.3159	27039.67		2.688619	5.669891	0	31.0957	31.0957	269.0276
	48.48147	44.12569	26.07601	300.0846	295.6519	12352.8		2.384024	3.651706	0	17.9406	17.9406	316.4802

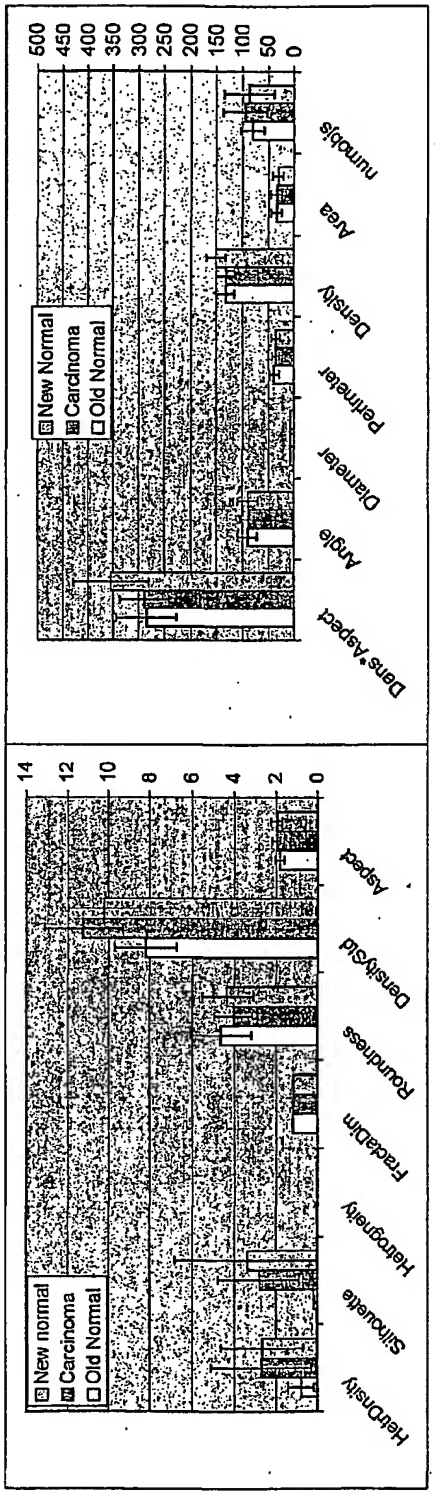

New normal
Carcinoma
Old Normal
14
12
10
8
6
4
2
0
HeirDnsty
Silhouette
Heterogneity
FractalDim
Roundness
DensityStd
Aspect
New Normal
Cardinoma
Old Normal
600
450
400
350
300
250
200
150
100
50
0
Dens*Aspect
Angle
Diameter
perimeter
Density
Area
numobjs

FIG. 14

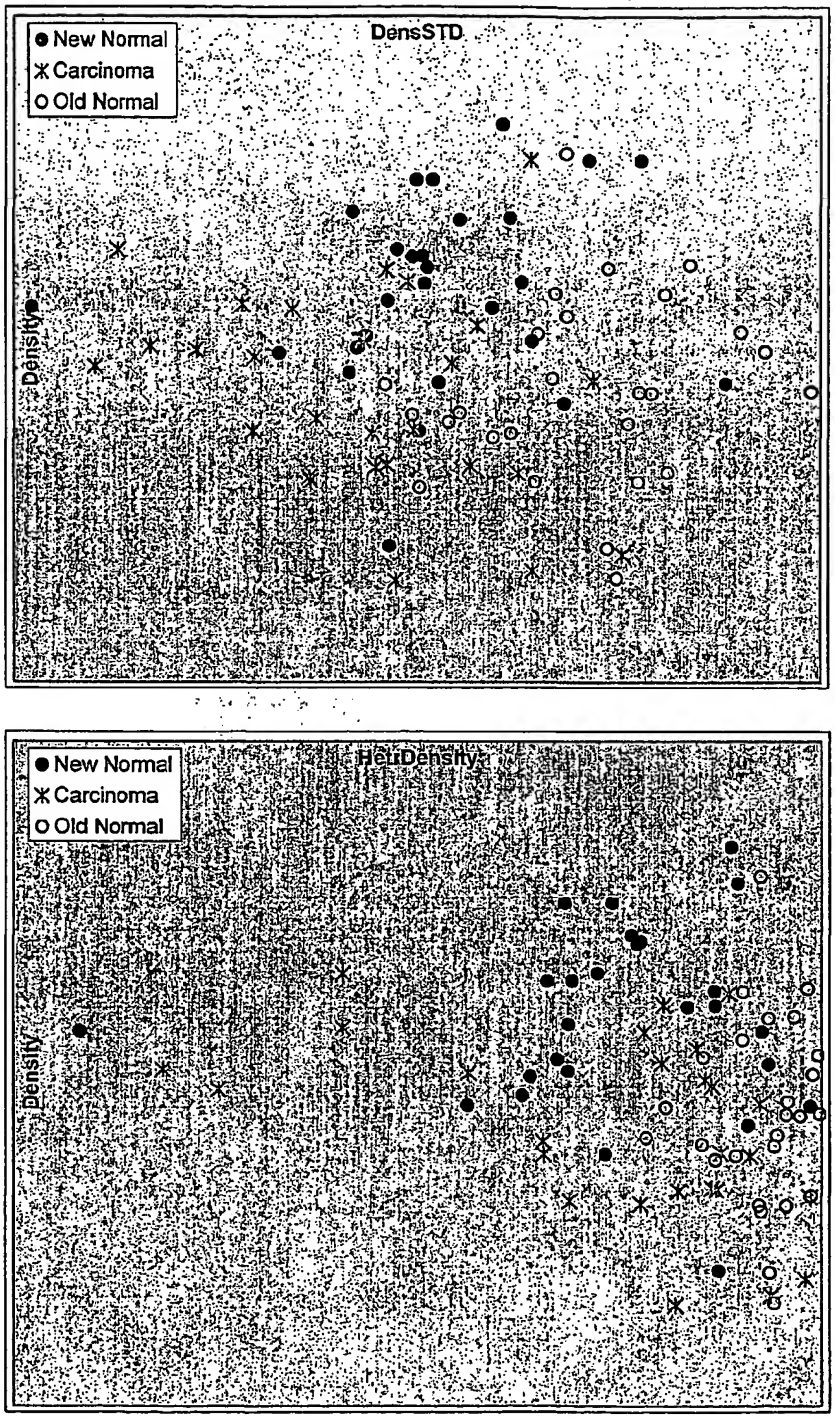

New Normal
Carcinoma
Old Normal
DensSTD
Density
New Normal
Carcinoma
Old Normal
HetrDensity
Density

FIG. 15 (1)

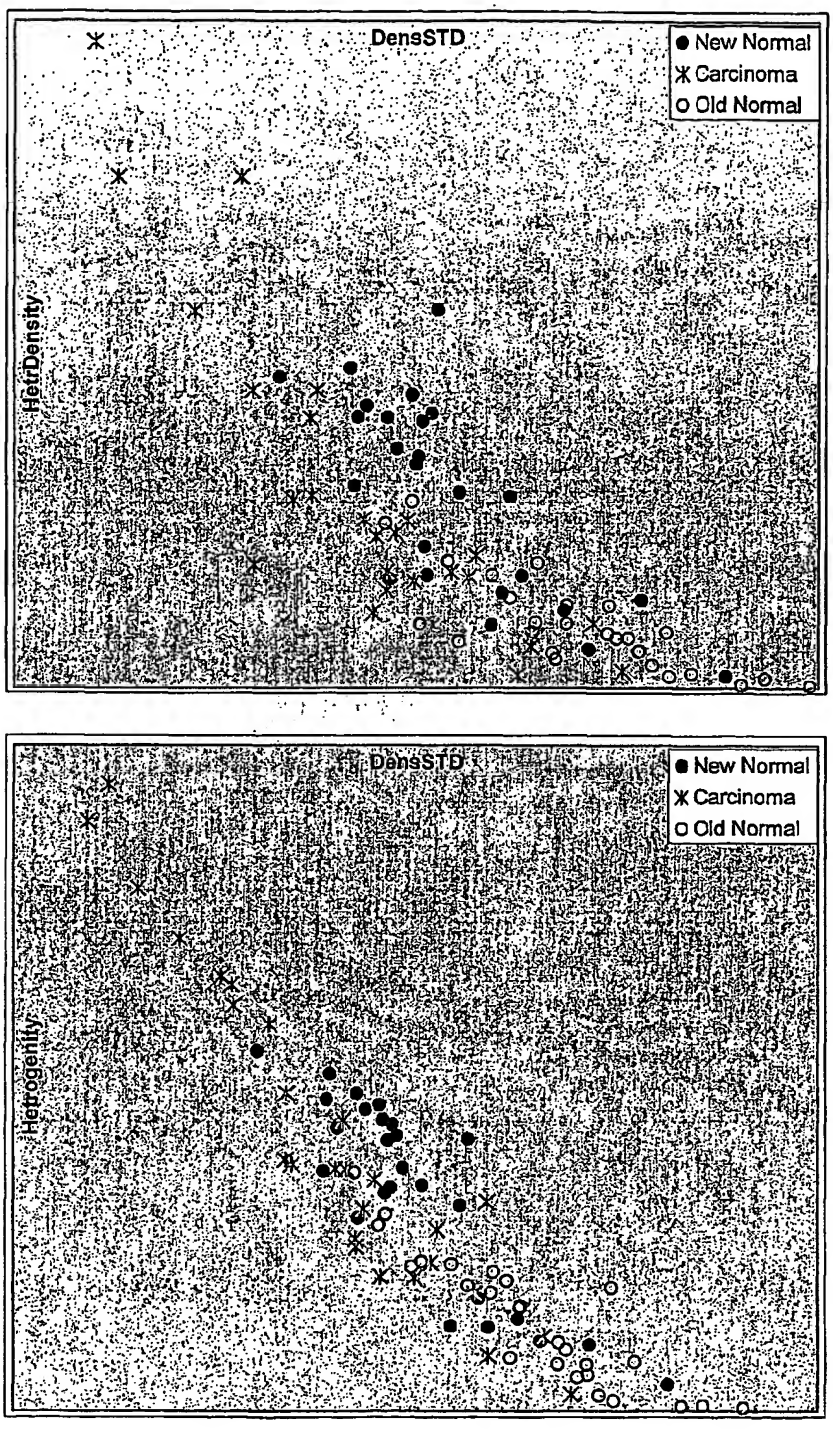

DensSTD
HetrDensity
New Normal
Carcinoma
Old Normal
DensSTD
Hetrogenity
New Normal
Carcinoma
Old Normal

FIG. 15 (2)

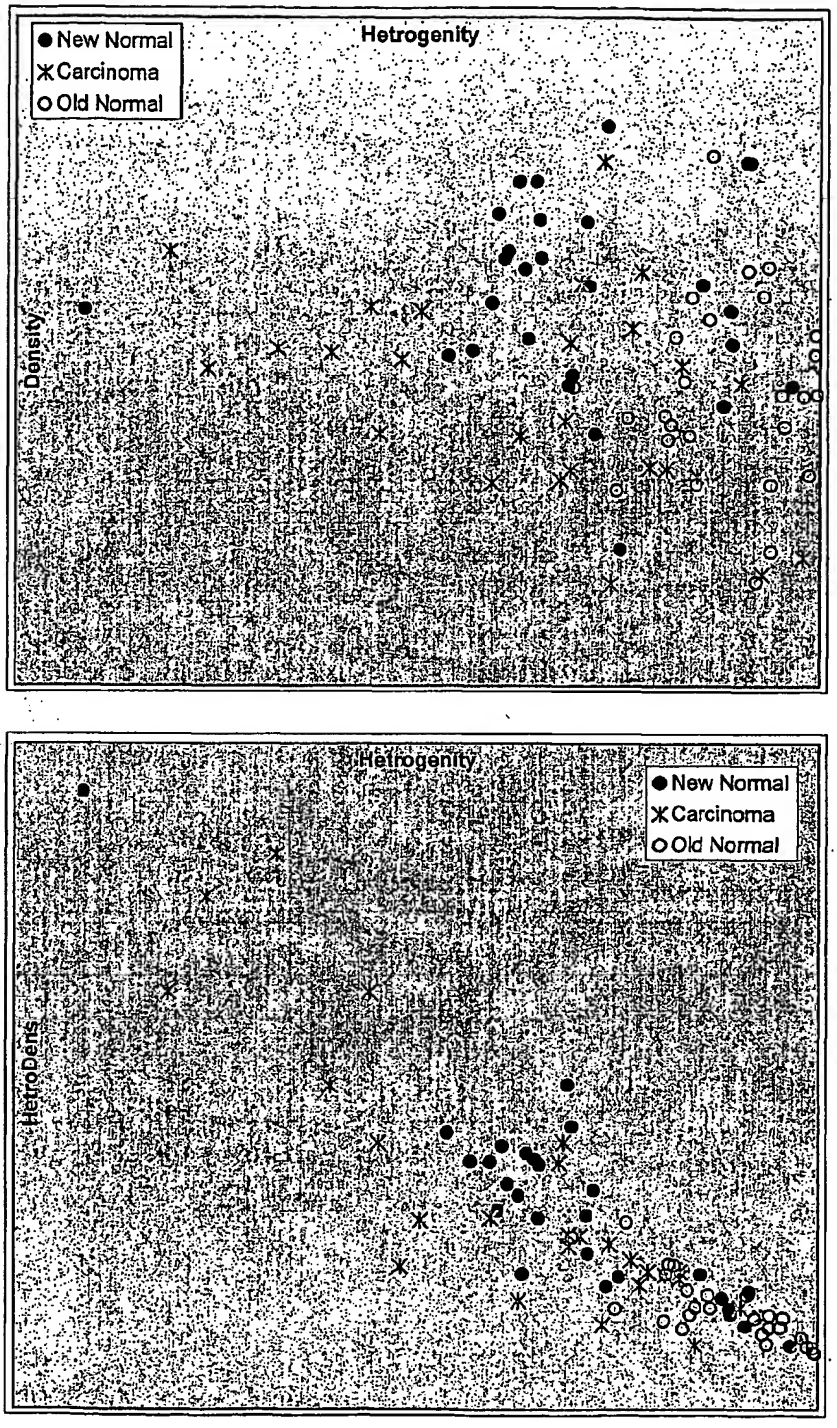

New Normal
Carcinoma
Old Normal
Hetrogenity
Density
Hetrogenity
HetroDens
New Normal
Carcinoma
Old Normal

FIG. 15 (3)

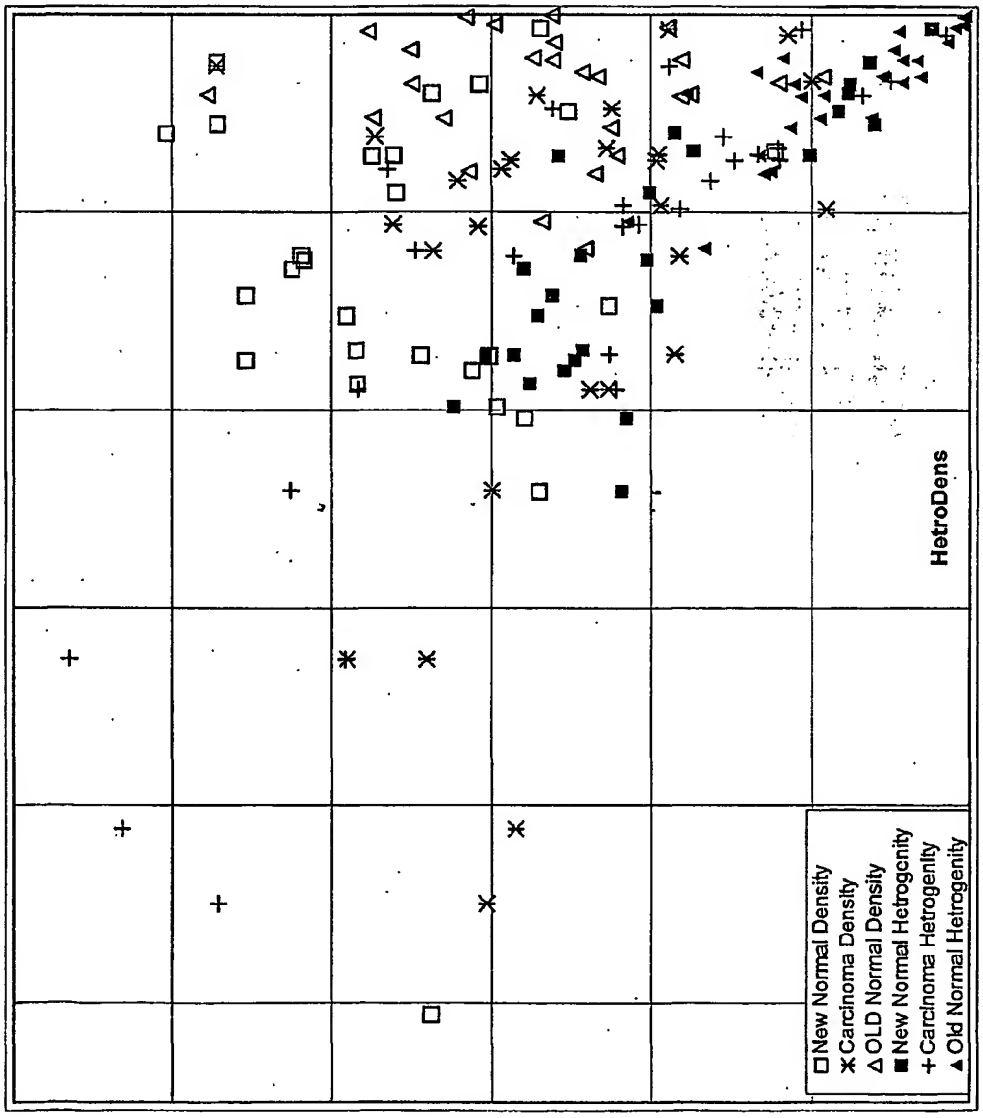

HetroDens
□New Normal Density
✱Carcinoma Density
△OLD Normal Density
■New Normal Hetrogenity
+Carcinoma Hetrogenity
▲Old Normal Hetrogenity

FIG. 16 (1)

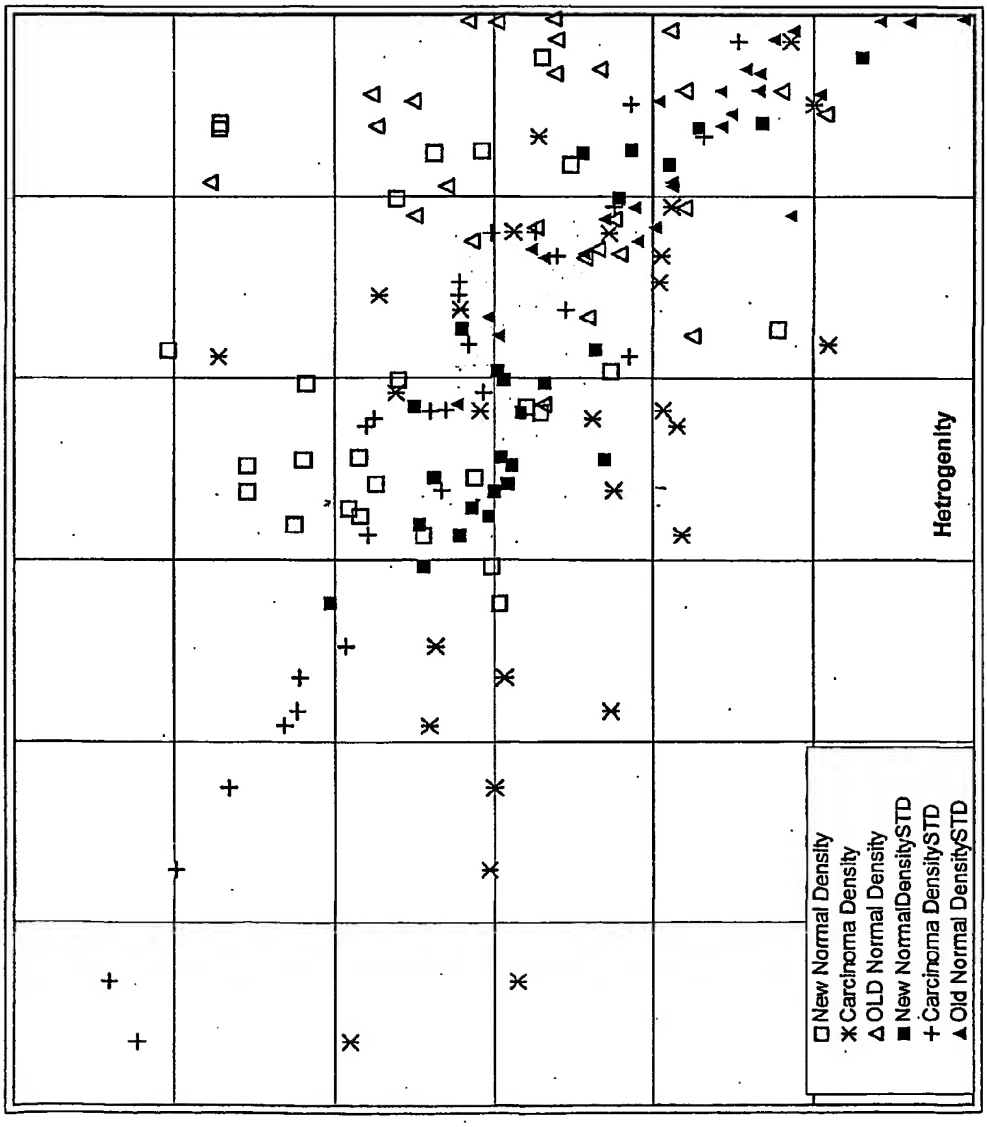

Hetrogenity
□New Normal Density
✱Carcinoma Density
△OLD Normal Density
■New NormalDensitySTD
+Carcinoma DensitySTD
▲Old Normal DensitySTD

FIG. 16 (2)

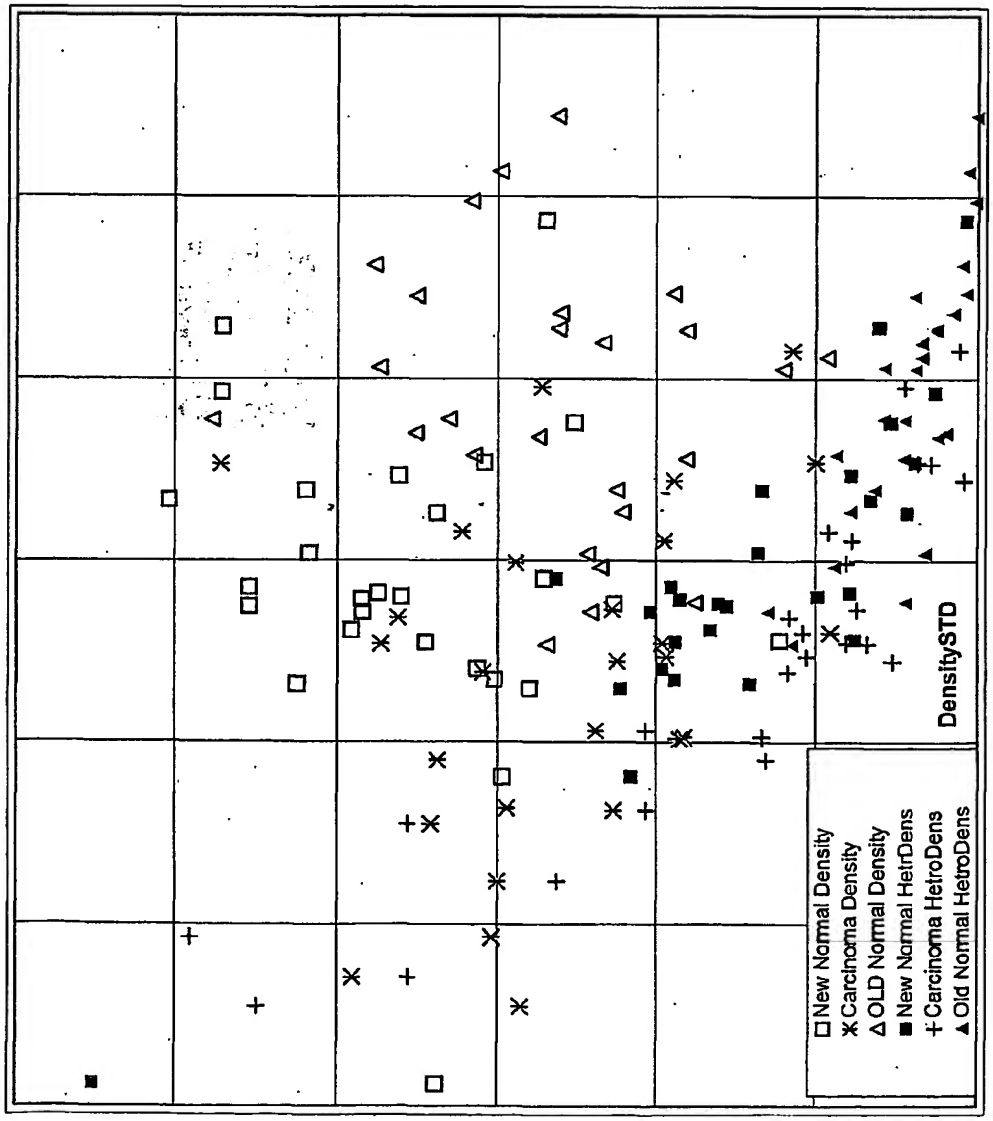

DensitySTD
New Normal Density
Carcinoma Density
OLD Normal Density
New Normal HetrDens
Carcinoma HetroDens
Old Normal HetroDens

FIG. 16 (3)

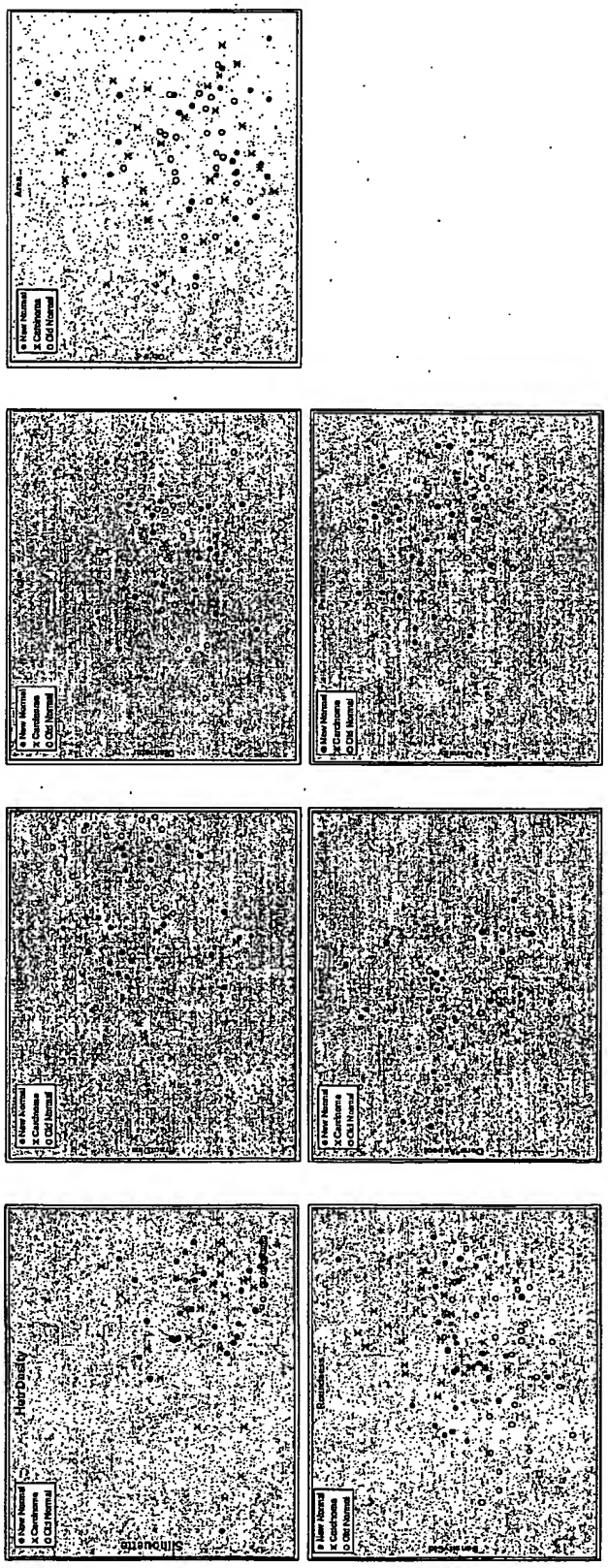
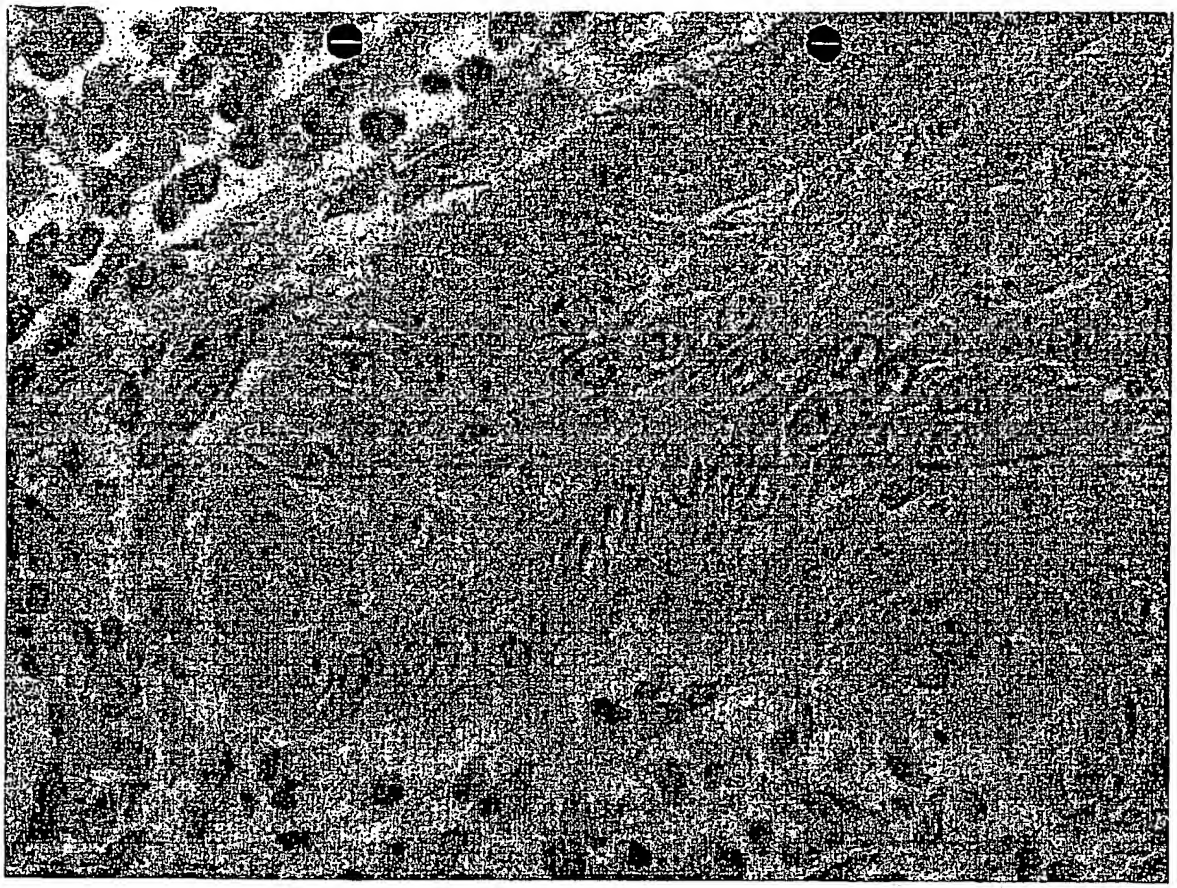
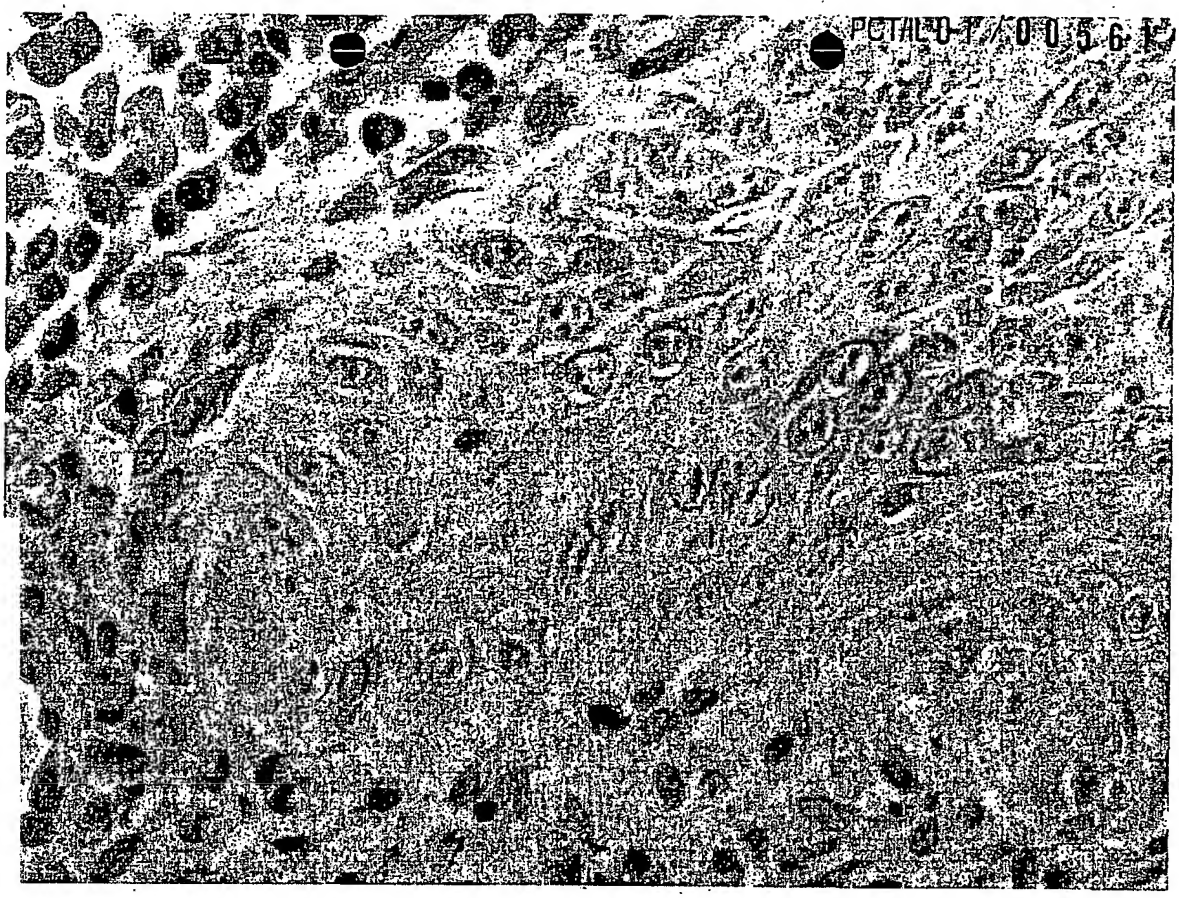

Area
Hair Density
Silhouette
Roundness
New Normal
Cardioma
Old Normal

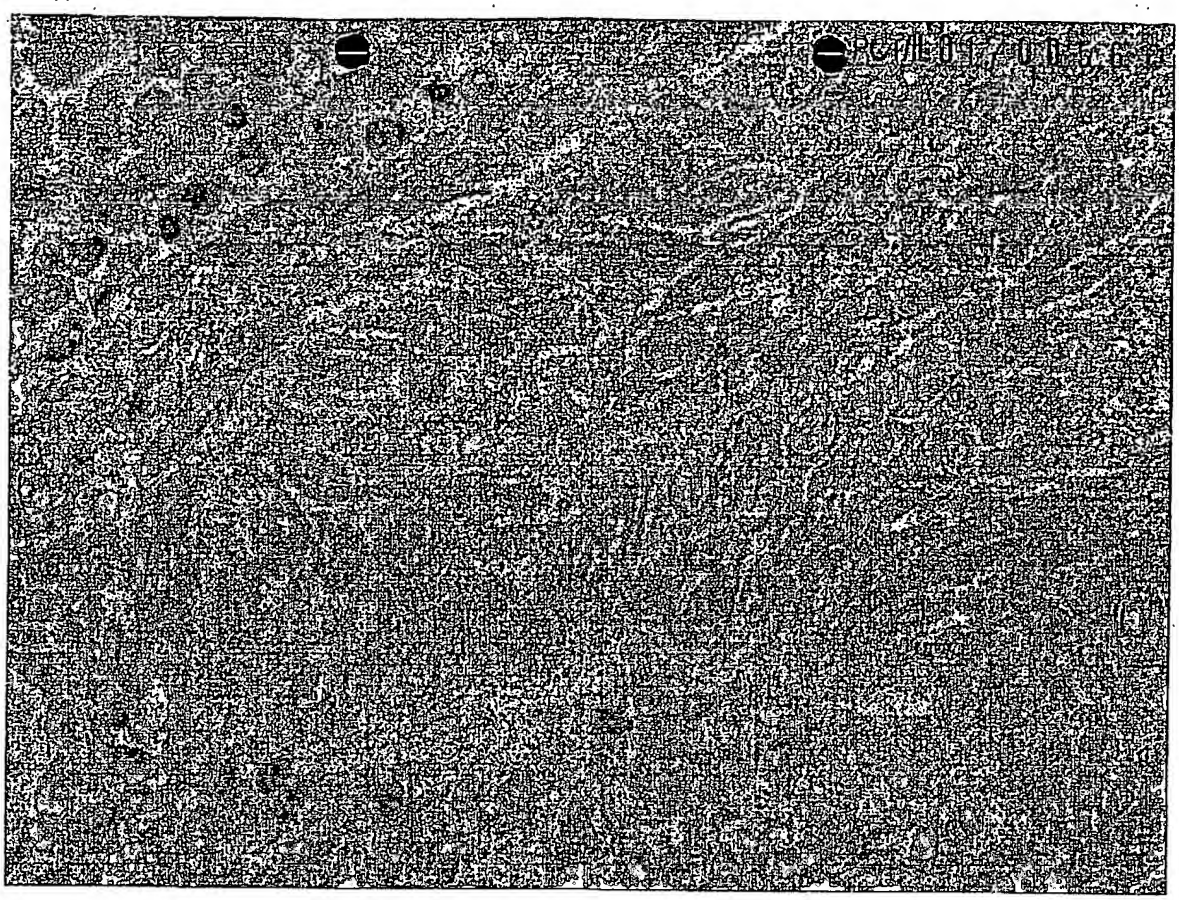
FIG. 17



18a.



18b.



18c.

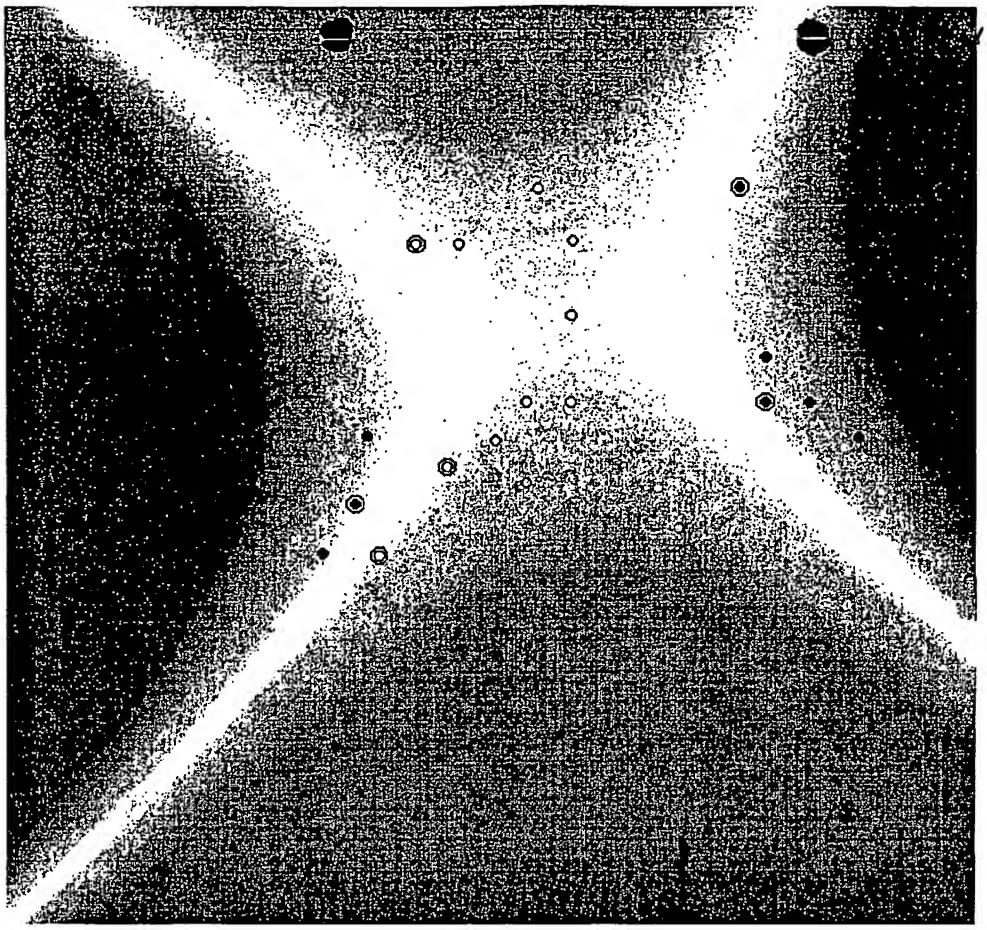


Fig. 19

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